TECHNOLOGY DEPARTMENT

Power Generation

and POWER PLANT ENGINEERING

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SEPTEMBER, 1948

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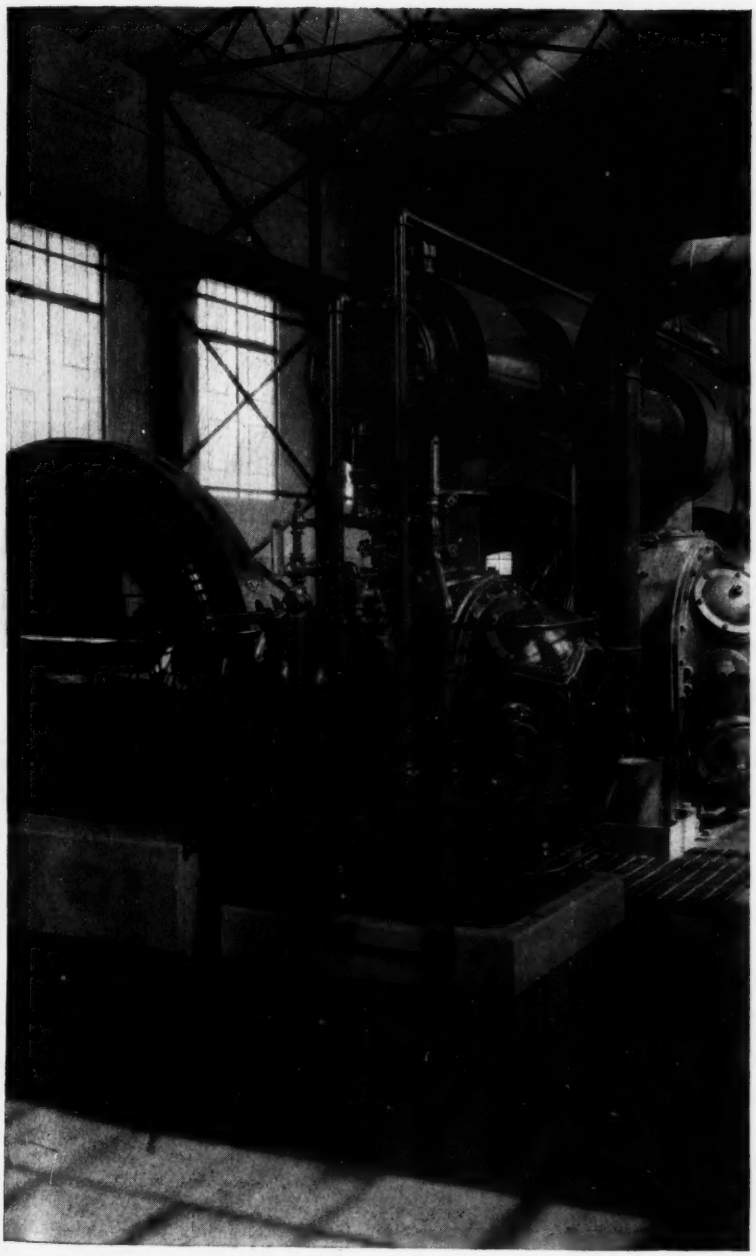
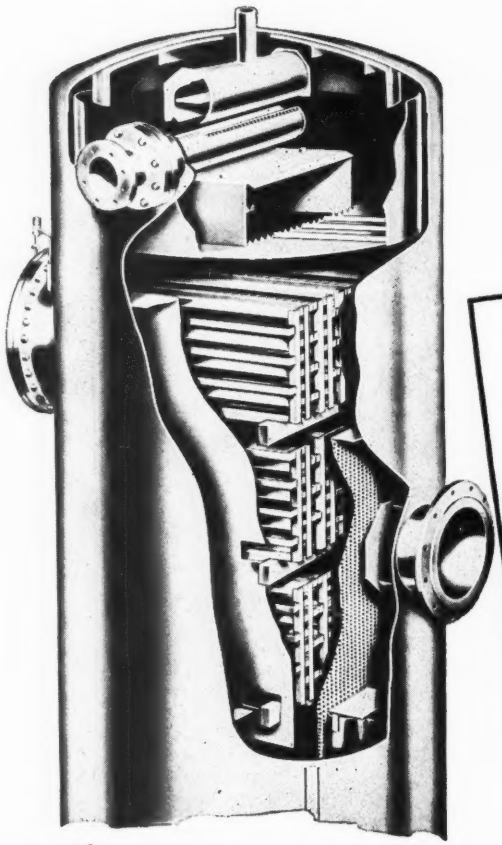


One of four 700-hp synchronous-motor-driven air compressors generating air power for operating rock drills and other air-operated equipment in an eastern "magnetite" iron mine. (Ingersoll-Rand photo)

For Power Engineers Responsible for Supply of Steam, Electricity and All Other Power Plant Services

NEW
toward



NEW THE Elliott
DEAERATING HEATER

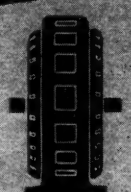
No tubular vent condenser is needed on this spray-tray deaerating heater, the function of the vent condenser being handled by a vent collecting hood and an inlet spray assembly. Maintenance costs are eliminated by the omission of the traditional tubular vent condenser and by the use of corrosion-resistant materials for all inner parts. In the new design the shell covers everything, eliminating certain piping and connections, and reducing headroom. Trays and baffles are of stainless steel requiring only occasional inspection.

NEW THE Elliott YR
MECHANICAL DRIVE TURBINE

This is a positive advance over the previous type of Elliott mechanical drive turbine, itself long an overwhelming favorite among engineers who place highest value on dependable performance. To this sound basis the new design adds greatly increased capacity without increasing frame size — higher speeds — higher back pressure — six elective types of governors, and greatly reduced maintenance cost, not only beause of longer service without attention, but also because of the savings made by the interchangeability of the precision-built parts, used in all sizes of turbines.

OTHER UNITS IN THE Elliott LINE UP . . .

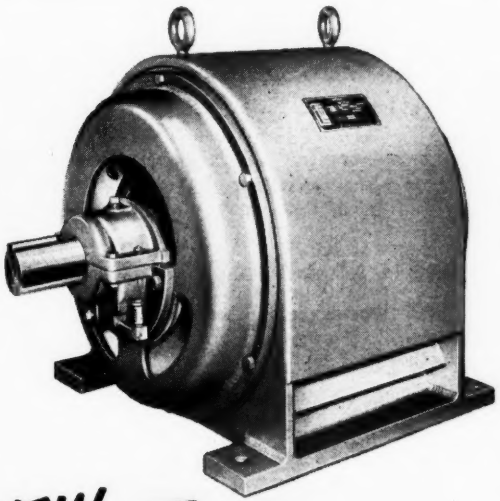
TURBINE-GENERATORS



GENERATORS for DIESELS

TURBOCHARGERS for DIESELS

LONG STRIDES
lower maintenance costs



NEW THE Elliott

"FABRI-STEEL" MOTOR

Applying for the first time in large motor construction the rigidity and crack-proof strength of fabricated steel, the Elliott "Fabri-Steel" motor achieves both new high performance and new low maintenance. The primary factor in its smooth, quiet operation is the uniformity of air gap, maintained by the rigid steel bearing bracket, precision-drilled with the end plate, and accurately located. The split sleeve bearings can be removed by merely taking off the bearing caps. The rotor can be pulled without shifting the motor from its base. Interchangeable parts permit stocking spares for quick replacement . . . 150 to 1000 hp, 4 to 14 poles, and in a variety of enclosures.

WITHIN RECENT MONTHS

Elliott engineering has advanced several new developments each in its way an important factor in reducing overall power costs.

These developments represent pioneering — striking out into new fields, guided by broad engineering experience, motivated by a constant desire for better products, and driven by a constant desire for better products, and driven by the courage which is an essential of all successful exploring.

Pioneering is a traditional Elliott characteristic, and assures that every unit of Elliott-built equipment reflects the latest thought in its particular field.

For descriptive bulletins on any of these products, address

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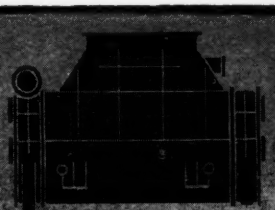

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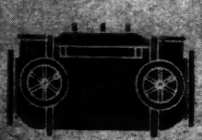
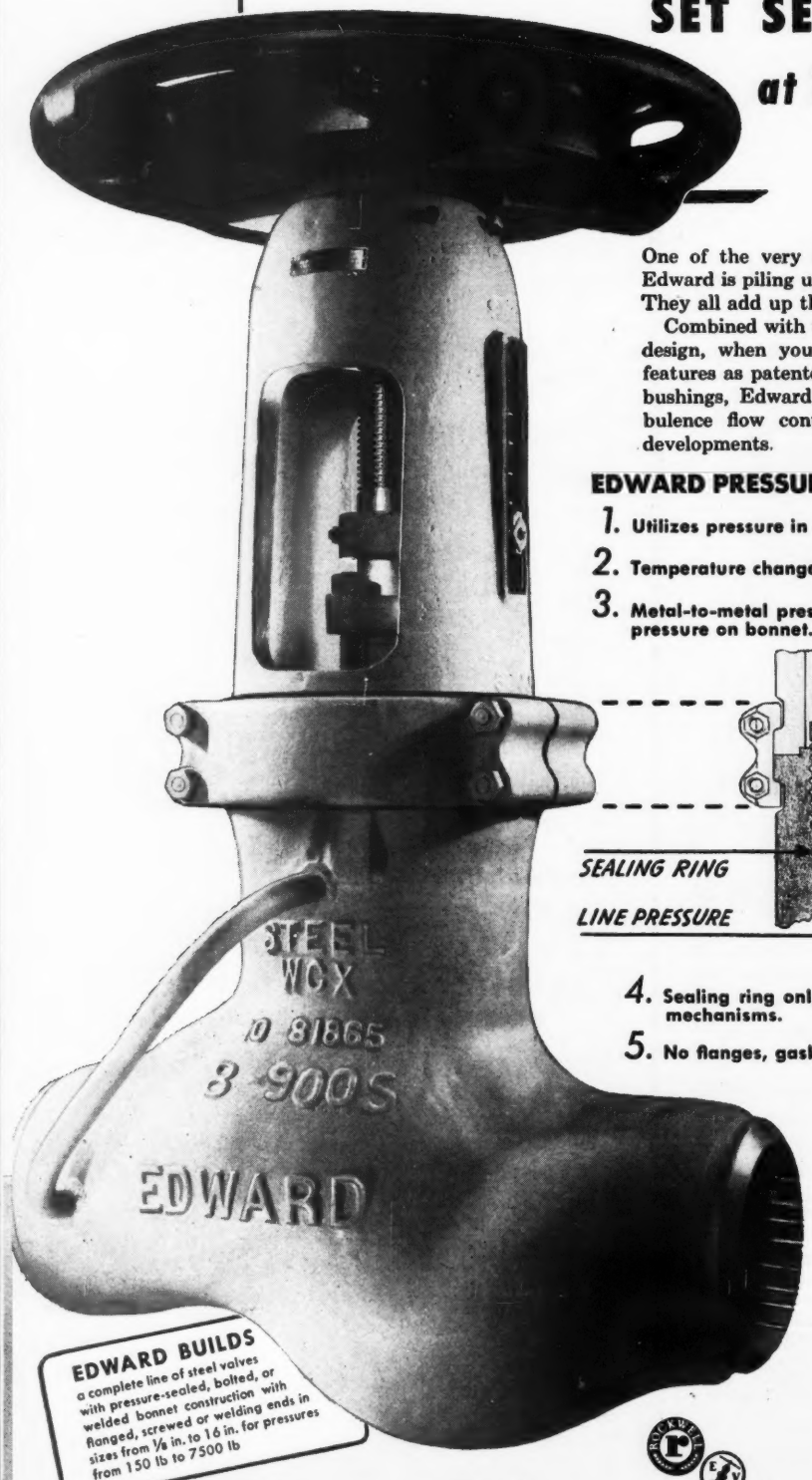
STEAM JET EJECTORS



STRAINERS

TUBE CLEANERS

Edward SELF-SEALING Bonnet Joints SET SERVICE RECORDS at TOP TEMPERATURES, PRESSURES

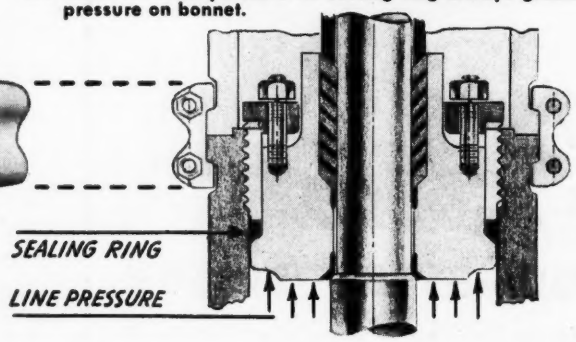


One of the very first builders of pressure seal bonnet valves, Edward is piling up experience reports from stations everywhere. They all add up the same—satisfaction.

Combined with the Edward experience on pressure seal bonnet design, when you specify Edward valves you get such extra features as patented Impactor handwheels and EValthrust yoke bushings, Edward Equalizer, closure indicators, controlled turbulence flow contouring, and many other exclusive Edward developments.

EDWARD PRESSURE SEAL BONNET JOINT FEATURES

1. **Utilizes pressure in valve to seal bonnet joint.**
2. **Temperature changes have no effect on bonnet joint tightness.**
3. **Metal-to-metal pressure on sealing ring always greater than line pressure on bonnet.**



4. **Sealing ring only seals—does not support yoke or closing mechanisms.**
5. **No flanges, gaskets or bolting to periodically re-stress.**
6. **Saves space—reduces weight.**
7. **Disassembly and reassembly, if ever required, greatly simplified and speeded up.**

EDWARD BUILDS
a complete line of steel valves with pressure-sealed, bolted, or welded bonnet construction with flanged, screwed or welding ends in sizes from ⅛ in. to 16 in. for pressures from 150 lb to 7500 lb

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Contents of back issues of Power Plant Engineering and Power Generation will be found in Industrial Arts Index on file in Public Libraries.

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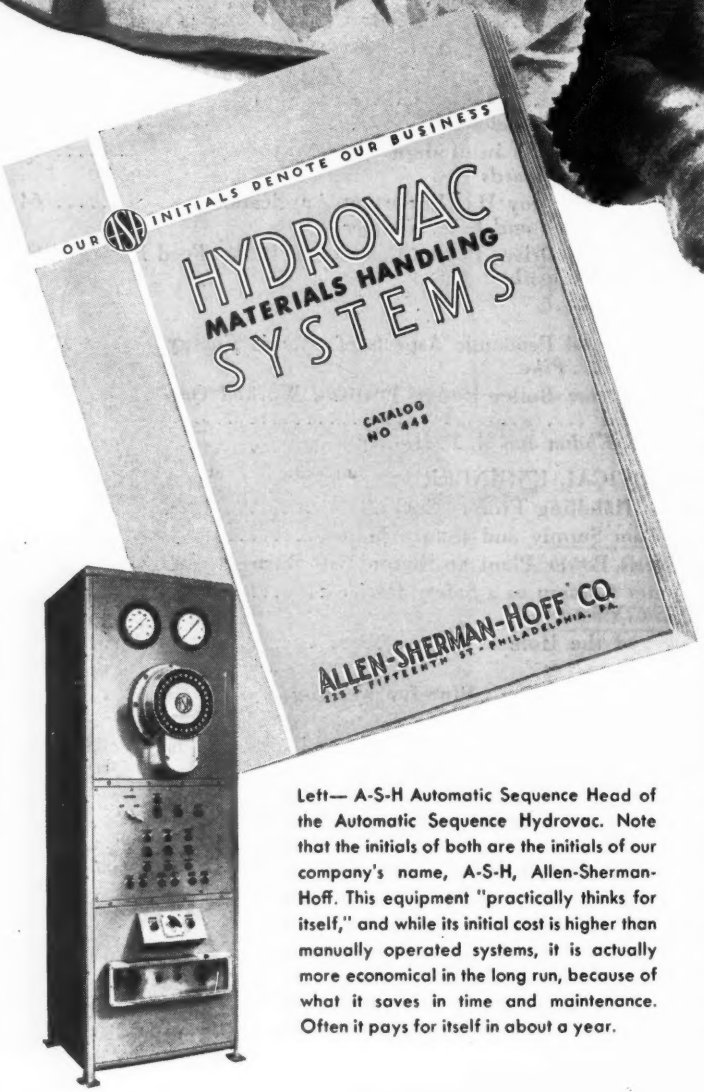
Lettin' the Cat outta the Bag!



Left— A-S-H Automatic Sequence Head of the Automatic Sequence Hydrovac. Note that the initials of both are the initials of our company's name, A-S-H, Allen-Sherman-Hoff. This equipment "practically thinks for itself," and while its initial cost is higher than manually operated systems, it is actually more economical in the long run, because of what it saves in time and maintenance. Often it pays for itself in about a year.

It took five long years of designing, experimenting and building to perfect the new Automatic Sequence Remote Control Hydrovac System for handling anything from the finest dust up to loose, bulk granular materials of various sizes. To the men and companies contributing to this development, quite aptly referred to as the "Pneumatic Materials Handling System of Tomorrow," we express our heartfelt thanks. . . . We are "Lettin' the Cat Outta the Bag" with the publishing of a new catalog, covering manual and automatic systems for handling material in metal and non-metallic mines, coal burning generating and heating plants, process industries, etc. . . . A letter from you will bring one of the catalogs very promptly. If your problem is urgent, tell us in the letter that you want an engineer to bring the catalog and discuss your particular job with you.

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ENGINEERS' PREVIEW

PRESSURIZED SMELTING, an invention that promises to increase the Nation's output of iron and steel by nearly 50 per cent, has been tested successfully in two converted blast furnaces at Cleveland and Youngstown, Ohio, according to Leonard Engle, reporting in the *Scientific American*. In the new process, instead of permitting the hot gases of the blast furnace to escape into the air, the furnace is partially sealed by a system of valves. These valves permit pressure to be built up in the furnace, resulting in a higher furnace temperature and faster chemical processes. Blast furnace pressurization is the invention of Julian M. Avery, vice president of the Hodges Research and Development Corp. It was first announced at the 1938 meeting of the AIM & ME, but did not receive full attention until 1944 when the War Production Board, hard pressed for additional pig iron and scrap, authorized initial tests on a full scale basis. Successful outcome of the Cleveland and Youngstown trials leads to considerable speculation on production of additional amounts of iron and steel and also to the practical utilization of low grade ores.

★ ★ ★

CONTRACT for development of Mexican oil resources has recently been announced as a cooperative effort between Mexico and a major American oil company, the Cities Service Co. Under the contract, Mexico-Cities Service Petroleum Corp., a Cities Service subsidiary, will provide capital for the exploration by Petroleos Mexicanos of more than a million acres of oil lands in northeastern Mexico, and exploration activities will be started immediately. Discovery of new oil reserves in Mexico close to American refineries and market, would be of the greatest importance at the present time. The development of these resources, easily accessible to water transportation and to world markets, could be carried on with minimum requirements for steel and other materials in short supply in the United States.

★ ★ ★

AS HAS HAPPENED so often during the past 7 or 8 years, Buck Rogers and Superman may again find themselves outdone and living in a humdrum, ordinary world. Taking the edge off their fantasies of the future, comes news that GE has established new facilities for development and testing of component parts of proposed jet-propelled helicopters.

★ ★ ★

TWO FINE PAPERS on the electric power situation here and abroad, by Walker L. Cisler, executive vice president of The Detroit Edison Co., have just been reprinted in booklet form by Edison Electric Institute, and additional copies of them can be obtained from the Institute at 420 Lexington Avenue, New York 17, N. Y. The first paper, which we abstracted on page 53, May, 1948, issue of POWER GENERATION, is a complete version of the paper Electric Power and Our National Defense presented at the 1948 Winter Meeting of the AIEE. The second paper is Mr. Cisler's detailed analysis of The Foreign Electric Power Situation, presented at the Midwest Power Conference, 1948, in Chicago, Ill. This contains tabulations of Marshall Plan power requirements and details of the existing systems in France, the Netherlands, Great Britain and the other countries of Europe, including Germany.

THOSE INTERESTED in the work of the Committee for Economic Development should get a copy of CED *Digest*, Vol. 2, No. 1, in which various members of the organization give detailed data on the various phases of CED work, which is now to be made permanent. A new CED Research Report, in the form of a book on small business by Dr. A. D. H. Kaplan, is soon to be released.

★ ★ ★

CONCRETE THAT SINGS was demonstrated at the 1948 Road Show in Chicago. This showed how ribbed white concrete highway safety markers could be constructed quickly and easily with simple tools. These markers produce a singing sound, which serves as a warning when a motorist strays from a traffic lane.

★ ★ ★

ROBERT W. WOLCOTT has gone to Germany, at the request of Secretary of Commerce Charles Sawyer, to see what can be done to eliminate the remaining obstacles standing in the way of shipment of scrap from Germany to the United States. Mr. Wolcott recently stated that this country's total inventory of scrap and pig iron is currently only 40 per cent of what it was just before World War II, and substantially less than the lowest inventory during the war. Steel production, he says, may miss its 1948 objectives by a wider margin than in 1947 unless iron and steel scrap can be promptly shipped to this country from overseas.

★ ★ ★

HOWARD N. EAVENSON has retired as President of Bituminous Coal Research, Inc., a position through which he continuously contributed to the progress of the industry with which he has been associated for 25 years. To succeed him, James B. Morrow has been elected president. Mr. Morrow is first vice president of Pittsburgh Consolidation Coal Co., Pittsburgh, Pa.

★ ★ ★

DEMONSTRATION-SCALE, synthetic fuels plant, costing over $4,000,000, will be constructed at Louisiana, Missouri, by Koppers Co., Inc., for the Bureau of Mines, to produce oil from coal by the Fischer-Tropsch process of gas synthesis. As scientific, engineering and economic knowledge is gained from the operation of this plant, it will be released to private industry for application in plants able to produce upwards of 10,000 barrels of synthetic fuels per day. The new plant is the third and last of the planned demonstration-scale units under the synthetic fuels research and development program of the Bureau of Mines. It is centrally located with respect to America's major coal fields and will test various coals and lignite for their processing characteristics and liquid fuel yields. It will work in close synchronization with the research and development laboratories at Bruceton, Pa., and Morgantown, West Virginia.

★ ★ ★

AT A RECENT engineering meeting, one of the speakers announced that tonight he was not going to try to be a big wheel but only a small wheel. "You know," he said, "the bigger the wheel, the longer the spoke—and the greater the tire."

EVER HEAR of tall oil? Webster says it is "from the Swedish Tallöl, literally pine beer." If that's so, it must have been not a short beer but a tall one. The name Tallöl is an American-Swedish-German hybrid. It describes a source of drying material, a little known product of the Nation's forests that is growing in importance. It is a sticky, dark, semi-solid material which has caught the attention of scientists throughout the world. Today it finds its way into soap, insecticides, herbicides, paint, varnish and enamels, and chemists are grooming it for other industrial applications. Dr. D. H. Wheeler, head of Fat and Oil Section, General Mills Research Laboratories, tells all about it in the Summer Edition of *Progress Thru Research.*

★ ★ ★

ANYONE who has as much stake in technological advancement as the capital goods manufacturer may have reason to be concerned about any slackening in the pace of traditional American inventive ingenuity. So says William J. Kelly, president of the Machinery and Allied Products Institute, in a bulletin to members. The all-time high in patent applications in the United States was reached in 1929 with 94,738 patents, including designs and re-issues. During the depression there was a decline of almost 40 per cent. Not until 1946 did patent applications approach the 1929 figure, and then, strangely, they began to decline again. Since 1930, Mr. Kelly points out, there has been about a 15 per cent increase in population and about a 15 per cent decline in patent applications. Britain's decline in patents granted was about 40 per cent between 1930 and 1946. Mr. Kelly's bulletin discusses in some detail a number of the factors advanced to explain at least part of the decline in the United States. He raises a point he has discussed before; that is, whether the decline in patent applications portends technological stagnation such as has overtaken Great Britain.

★ ★ ★

POLE-VAULTING THE HORIZON is the latest thing in television. In normal television, the highest practicable tower erected on the ground can transmit television broadcasts only 35 to 50 miles. So, as reported many months ago in these columns, Westinghouse suggested the idea of transmitting a telecast up into the air, to be received and rebroadcast by an airplane flying slowly around in a circle. The plane could then re-transmit the broadcast in the form a giant inverted ice-cream cone, thus reaching an area on the earth's surface about 500 miles in diameter. The process, now called stratovision, was used commercially for the first time on June 23 by Westinghouse and Glenn L. Martin Co., to televise a session of the Republican National Convention at Philadelphia. A network of 14 such stratovision stations would cover 51 per cent of the nation's area containing 78 per cent of its population.

★ ★ ★

UNITED STATES Rubber Co. is now putting nylon on electrical wire. The nylon forms a hard shell over the rubber insulation, giving the conductors better protection. The new wire is 30 per cent smaller in diameter than conventional building wire. It takes up less room in conduit, permitting the use of more conductors. The nylon is applied as a hot liquid over two layers of natural rubber and neoprene synthetic rubber, and cools hard and smooth. The new wire is claimed to be resistant to gasoline, oil, fire, moisture, acids and light. It will be marketed under the name Neolay, Type RU, in sizes 14, 12, 10, 8 and 6.

PLANS FOR A TUNNEL under the English Channel between England and France, originally proposed nearly 200 years ago by a French engineer named Desmarets, are again being discussed by French and British engineers in London. For a great many years this question has been opened up from time to time, various schemes proposed, including both tunnels and bridges across the Straits of Dover; many borings have been made in the Channel to determine the earth structure, many machines designed for tunneling. The latest plan, worked out in 1930, included complete designs for traffic tunnels under the Channel. At one time, around 1881, the Anglo-French Submarine Railway Co. with the sanction of the British government, actually started experimental work. A large compressor plant was built at Sangatte, France, and a tunnel heading 6,000 ft. long was actually driven; but work was stopped in 1883. To construction engineers, the whole idea makes a most interesting story, which is told in great detail by G. J. Constantini in the July, 1948, issue of *Compressed Air Magazine.*

★ ★ ★

BOGGS was proudly showing his new sedan to Joggs. "I thought your other car was less than a year old," said Joggs. "You drove it only about 8,000 miles, didn't you?" "Oh, yes, it was still as good as new, but of course it was hopelessly out of date as soon as the new and improved model came out." "In what way is the new model different?" "Well, you can see at a glance. The automatic cigar-lighter is an inch nearer the steering wheel this year."

When we saw this in *The Kablegram*, we thought it was not only funny but that it might have some kind of social significance as a comment on the automobile industry. Now, however, we don't think it's funny at all because we have just seen the advertisement of a new gadget that delivers to the car driver a cigarette already lighted!

★ ★ ★

SPEAKING of a tunnel under the English Channel as we were a moment ago, here's another proposal—a floating steel and concrete tunnel nearly 3 miles long to bear four lanes of vehicular traffic, estimated at 10,000,000 cars annually, was envisioned before the summer convention of the ASCE as the only type of structure possible to link Seattle with the 5,400 square miles on the Olympic Peninsula across Puget Sound. The top of the tube would be 50 ft below the water's surface and its upward lift would be resisted by live load anchors weighing 500 to 600 tons each and resting on soft bottom material in water as deep as 800 ft.

★ ★ ★

DUNKERETT is one of the latest developments in onward march of American civilization. This is a ready-to-use half doughnut designed for dunking purposes, to further the cause of dunking in America, reports *The Power Specialist.* Dunking doughnuts, according to a recent Emily Post pronouncement, is socially correct provided you break the doughnut in half before immersing it in the caffeine solution. So, with the backing of an authority than whom there is no whomer, the bakers are exhibiting the full fruits of their free enterprise system. However, it raises a serious question. Here is the Dunkerett with only half a hole instead a whole hole, so how will that affect all the limericks, songs and sapient philosophical observations—like "Keep your eye upon the doughnut and not upon the hole"—with which Americans are so familiar?

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extra margin of safety

Texaco Regal Oils (R & O) give extra protection against rust, sludge and foam

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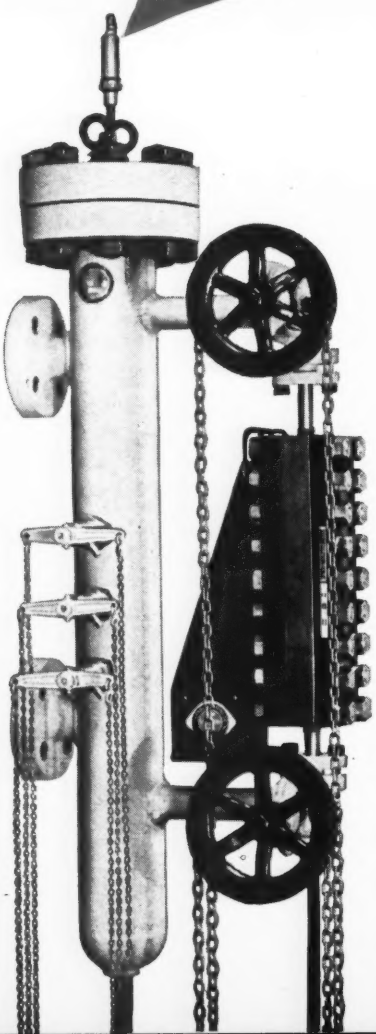

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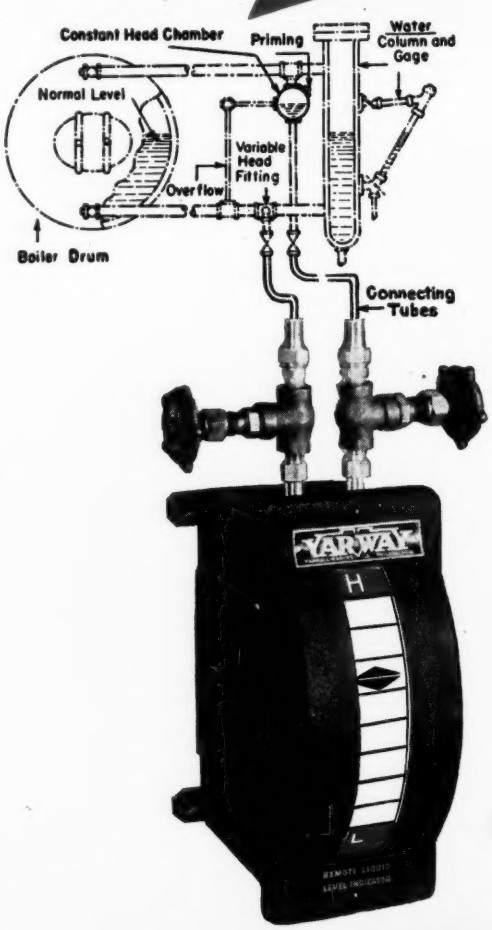
YARWAY REMOTE BOILER WATER LEVEL INDICATORS



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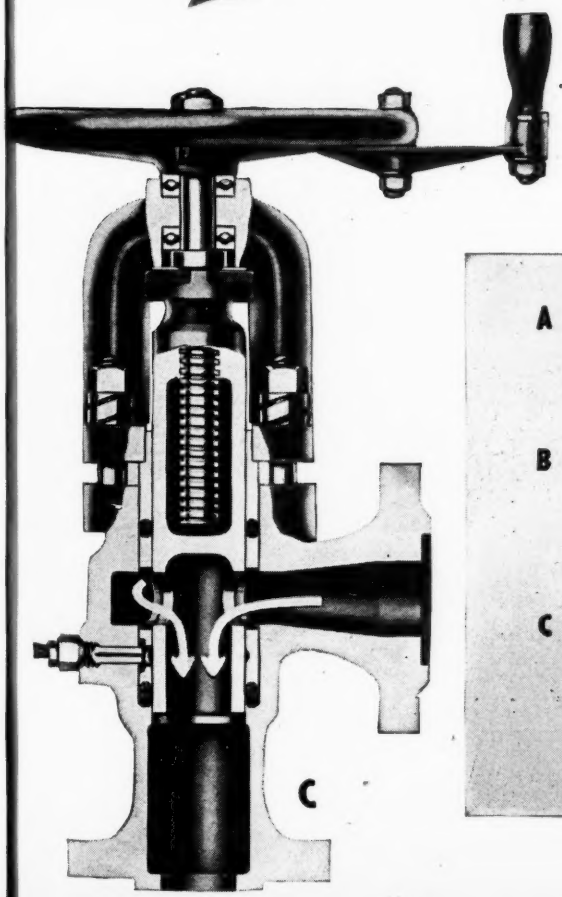
RESPONSIBILITY

all 3 FROM YARWAY

YARWAY BLOW-OFF VALVES



Power plant engineers may simplify responsibility by insisting that all three of these important boiler trim items be Yarway.

Why, you ask?

First, responsibility for the satisfactory performance of all three is centered in one company.

Second, Yarway's extensive service organization, with branches in principal cities in the United States and Canada, is conveniently at your service.

Third, each product has an outstanding feature—an *engineering reason,* laboratory-tested and field-proved for better performance.

For more complete facts on these and other products in the Yarway line of steam plant equipment, write for Yarway's all-products Catalog G-1306.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

A — Yarway Hi-Lo Alarm *Floatless* Water Column with patented Yarway Flat Glass Gage featuring a "floating assembly" that practically eliminates glass breakage. For pressures from 400 to 2500 psi. Other Yarway Columns and Gages for lower pressures. Write for Yarway Bulletin WG-1811

B — Yarway Remote Boiler Water Level Indicator that brings overhead readings right down to eye level, on instrument panel or other convenient place. Always accurate because it's operated by the boiler water itself. Action is instant, constant. *No stuffing boxes.* Moderate in price. Easy to install. For all pressures to 1500 psi. Write for Yarway Bulletin WG-1822.

C — Yarway Seatless Blow-Off Valve. No seat to score, wear and clog with mud, scale and dirt. Balanced sliding nitralloy plunger simplifies operation. Also furnished in Tandem, or as a Unit Tandem combined with a Yarway Hard-Seat Valve for highest pressures. Write for Yarway Bulletin B-424 for pressures to 400 psi; Bulletin B-432 for pressures to 2500 psi.

STEAM PLANT EQUIPMENT

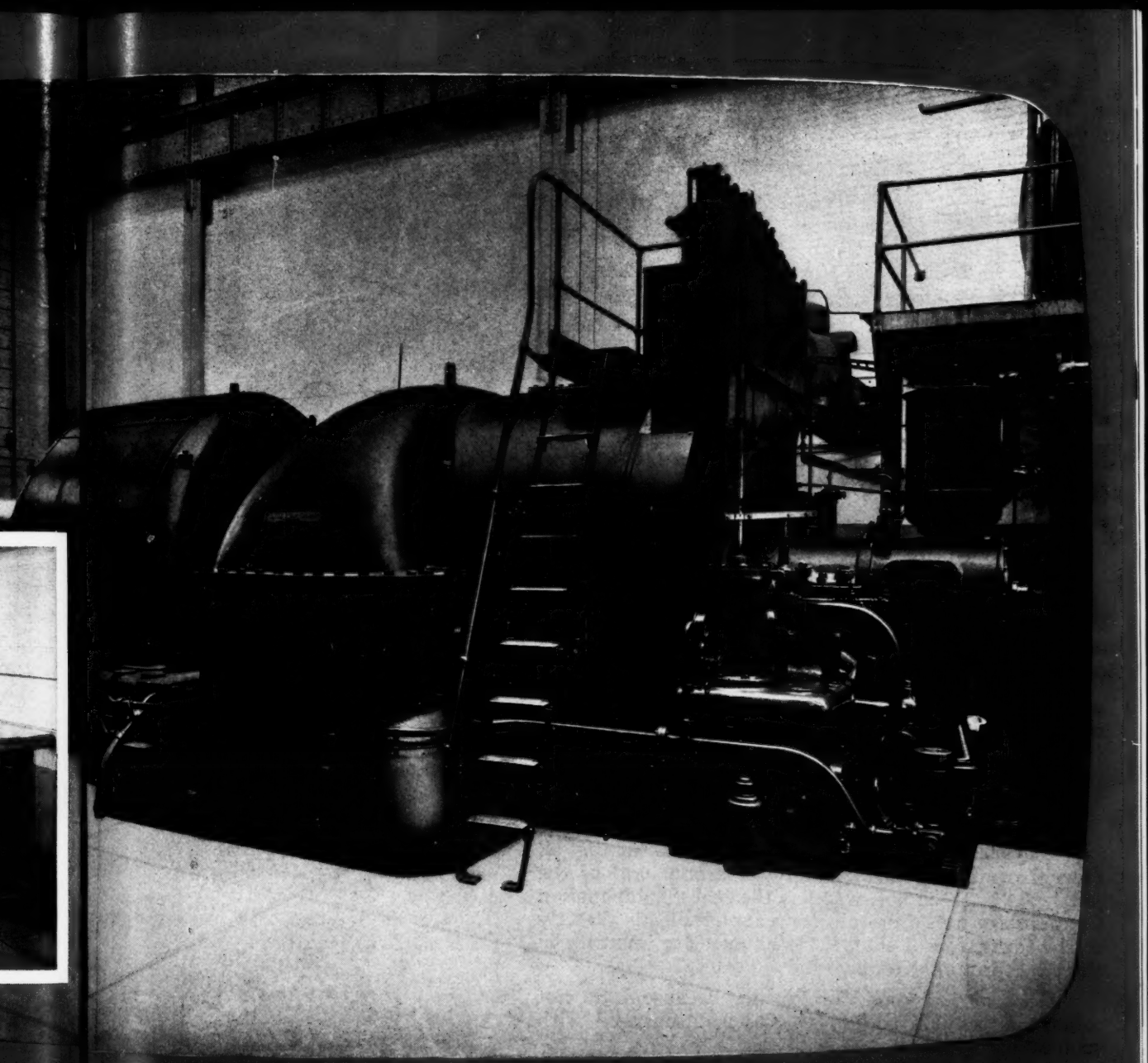
Is your turbine operation this safe?

In 1938, the midwest utility plant shown at right put Nonpareil Turbine Oil into a 6,000 KW unit. A year later, a shift to Nonpareil was made on one 10,000 KW turbine and, in 1941, on a second 10,000 KW unit. The original fills of oil have not needed to be removed or replaced in the seven to ten years of operation. The oil has not been treated or rested, yet neutralization numbers have stayed below 0.10. Results: no outage time for oil-system maintenance, no downtime due to acidity troubles. Moreover, these turbines are protected against such outages for the life of each unit.

Nonpareil Turbine Oil will not increase in acidity above 0.15 mg. KOH/gm no matter how long it remains in the turbine. This is guaranteed in writing and is borne out by performance records covering 20 years. Nonpareil assures clean operation because (1) deposit-forming hydrocarbons are removed from the oil by the refining process . . . (2) acidity increase and the formation of sludge are prevented by an oxidation inhibitor in the oil. To clinch safe turbine operation, an anti-foam agent and a corrosion inhibitor are added to Nonpareil.

A Standard Oil Lubrication Engineer will be glad to supply you facts and figures from 20-year service records of Nonpāreil Turbine Oil. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STA



Nonpareil
Turbine Oil

ANA STANDARD OIL COMPANY (INDIANA) STANDARD

I DO TWO JOBS

BETTER THAN ANYONE ELSE

"I am De Laval Centrifugal Force. I purify lubricating oil, and because I can do two jobs at once I offer more complete protection for plant operating men.

"The two jobs I do? Well, I

1 — Remove dirt and sludge

2 — Remove water continuously

"I never do an incomplete job of maintaining oil (for in purifying oil, dirt removal is only ***part*** of the job). As often as not, water is the real trouble-maker. Condensate in turbine oil, for example, leads directly to the formation of sludge. Whatever the impurity in the oil, I promptly remove it.

"I am also a good Oil Purifier because I do not remove oil-soluble additives. Oil is discharged with such additives intact.

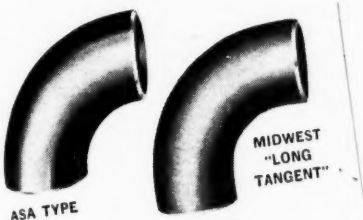
- "Read about me in Bulletin 400."

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL

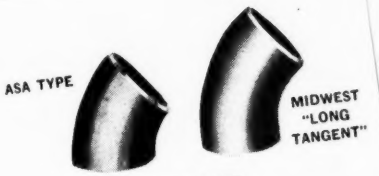
Lubricating Oil Purifiers

IMPROVE PIPING DESIGN and REDUCE COSTS with . . . MIDWEST WELDING FITTINGS



90° ELBOWS

REDUCING ELBOWS

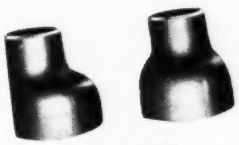


45° ELBOWS

180° RETURNS

TEES

REDUCING-ON-RUN TEES

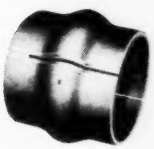


REDUCERS

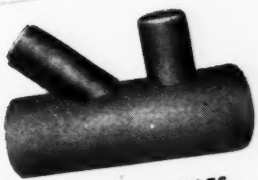
LAP-JOINT STUB ENDS

CAPS

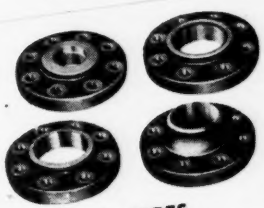
SADDLES



SLEEVES



SHAPED NIPPLES



FLANGES

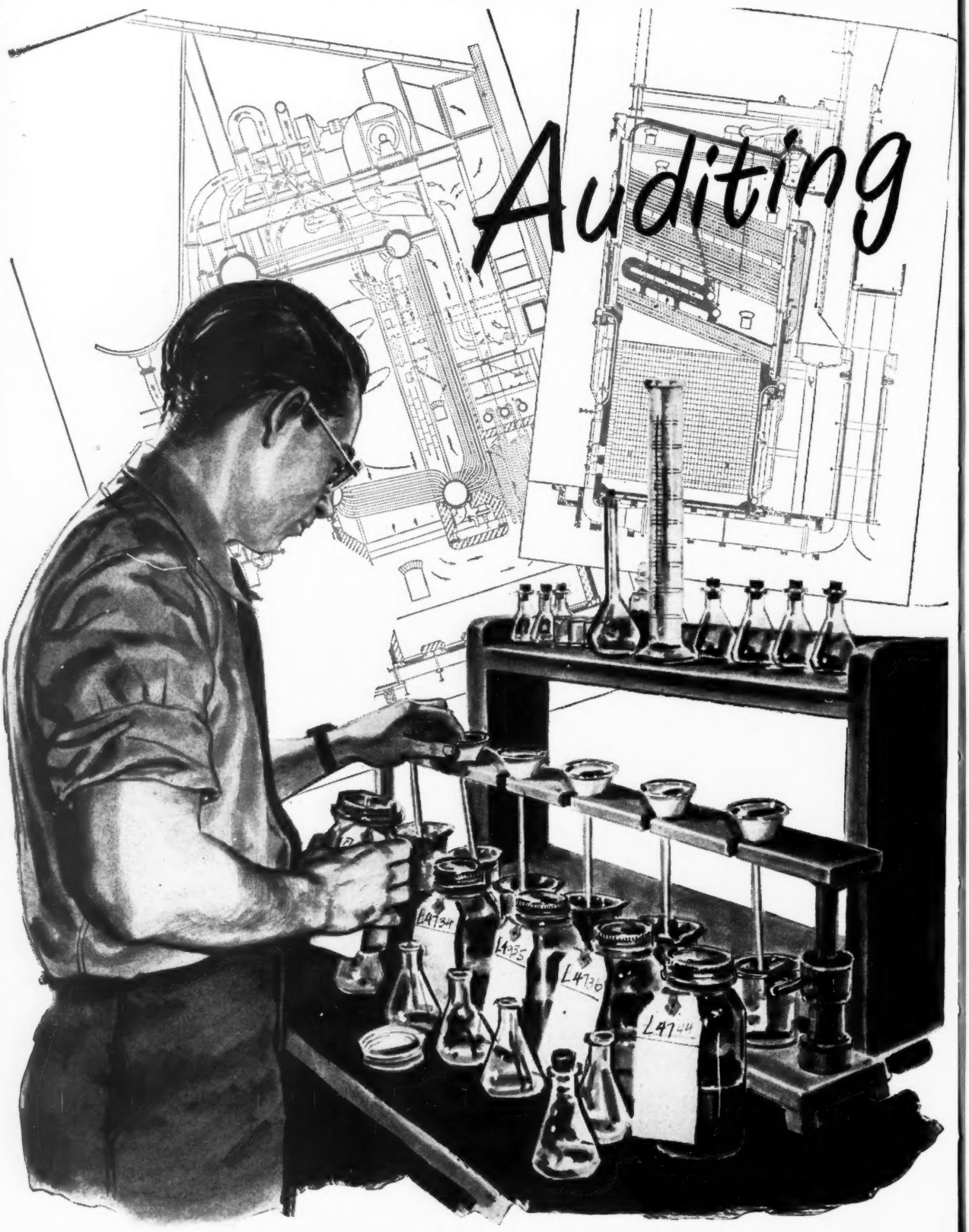
To simplify and improve piping design, Midwest originated and developed many of the fittings shown here. For example: the Midwest Reducing Elbow (available in sizes including 12") decreases turbulence and pressure drop when used instead of a standard elbow and a reducer; more than one third of the welding is also saved. Midwest Long Tangent Elbows save pipe and time in lining up. Midwest Saddles compensate for weakening of header body resulting from metal removed for nozzle opening. Midwest Welding Fittings stocks are carried in all principal cities . . . get in touch with your distributor.

MIDWEST PIPING AND SUPPLY COMPANY, Inc.

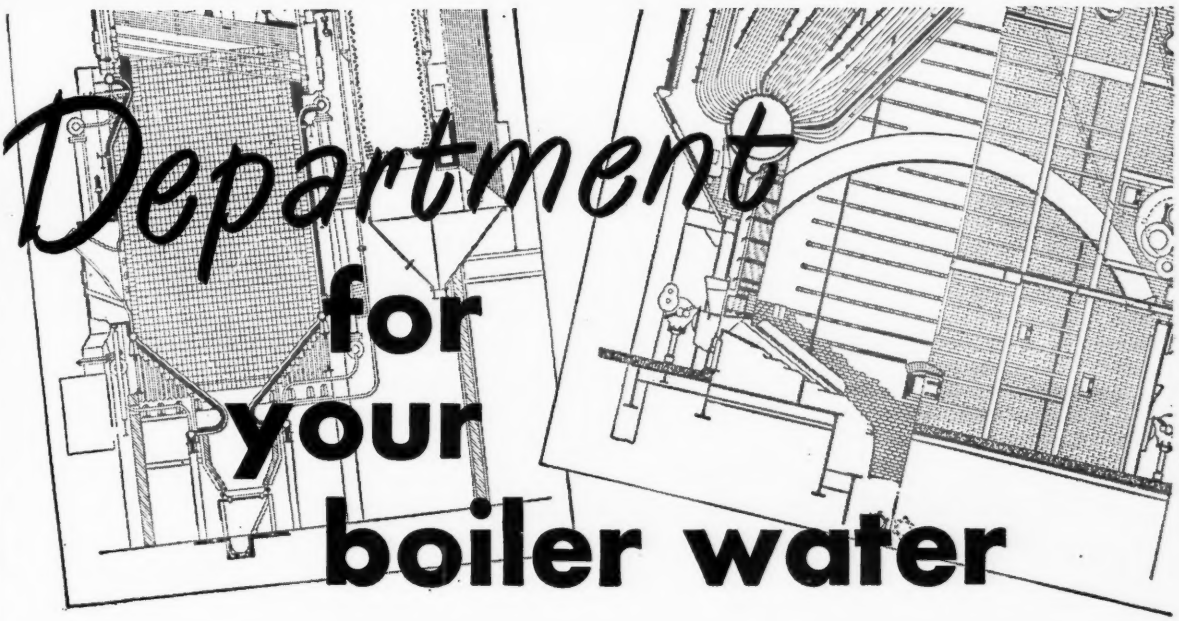
Main Offices: 1450 South Second Street, St. Louis (4), Mo.

Sales Offices: New York (7), 30 Church St.
Chicago (3), 79 West Monroe St. • Los Angeles (33), 520 Anderson St. • Houston (2), 229 Shell Bldg.
Tulsa (3), 533 Mayo Bldg. • South Boston (27), 426 First St. • Distributors in Principal Cities.

Auditing



Filtering samples of boiler water. Thorough removal of suspended solids is an essential first step in many testing procedures.



Department for your boiler water

One part of the service of Hall Laboratories is the periodic analysis of samples of boiler water and other waters from the plants of its clients, and checking these against analyses made by plant personnel for day-to-day control. The usual result of this "auditing" is assurance that proper conditions are being maintained—but in some instances it prevents possible trouble or ends needless expense.

Testing for organic matter, for example, may show the presence of oil—which would not be detected by the usual tests at the plant—and thus enable the plant to stop oil contamination before it causes serious trouble.

Or we may find that reserve phosphate in the water is considerably less than is shown by plant tests. A quick warning goes to the operator, together with the suggestion that he see if the calcium phosphate sludge is being thoroughly removed before samples are tested.

Again, we may find that reserve phosphate is unnecessarily high—which may mean that phosphate is being wasted or that tests are being made with a weak molybdate solution instead of the recommended reagent.

Our files contain hundreds of similar examples showing the value of the *continuing service* given by Hall Laboratories to plants of all sizes, in all parts of the country. Every problem concerning the industrial use of water comes within the scope of Hall service, and correspondence concerning your problems is invited.

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

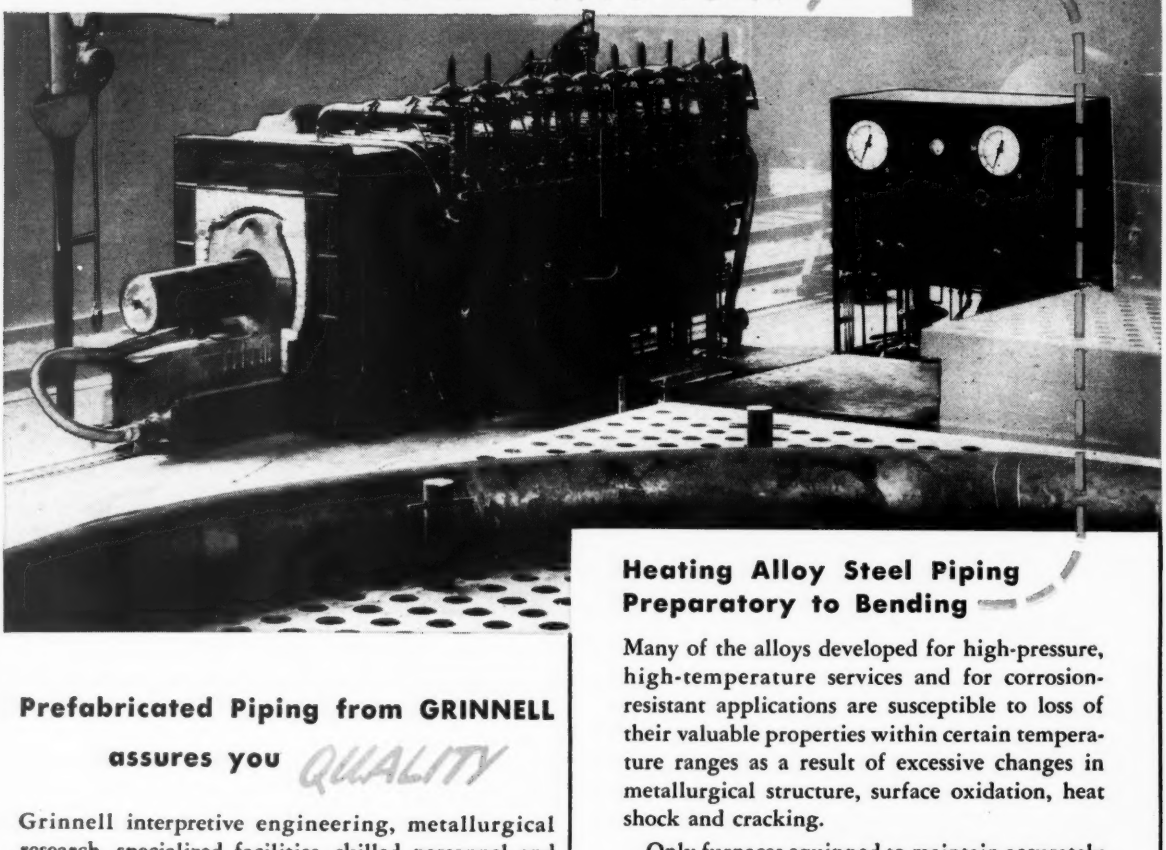
HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

HAGAN HALL BUROMIN CALGON

IF THERE EVER WAS A JOB FOR SPECIALISTS– *THIS IS IT!*



Prefabricated Piping from GRINNELL assures you *QUALITY*

Grinnell interpretive engineering, metallurgical research, specialized facilities, skilled personnel and rigid inspection, assure delivery of pretested and certified piping sub-assemblies which meet all governing code requirements.

Prefabricated Piping from GRINNELL assures you *ECONOMY*

One source for design and fabrication. Coordination of shop production under ideal conditions. Predetermined but flexible delivery schedules. Elimination of waste by paying only for finished assemblies. Reduction in field assembly time.

Heating Alloy Steel Piping Preparatory to Bending

Many of the alloys developed for high-pressure, high-temperature services and for corrosion-resistant applications are susceptible to loss of their valuable properties within certain temperature ranges as a result of excessive changes in metallurgical structure, surface oxidation, heat shock and cracking.

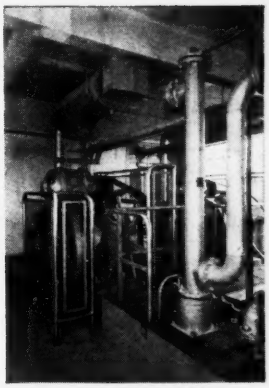
Only furnaces equipped to maintain accurately the specified temperature of the pipe are capable of retaining and safeguarding the metallurgical properties which dictate the choice of material.

Grinnell's modern pipe fabrication equipment includes specially designed gas-fired *radiant heat* furnaces, with such features as strategic location of multiple burners providing uniform temperature distribution and preventing harmful flame impingement, close temperature and time controls, automatic regulation, recording instrumentation and car loading.

GRINNELL COMPANY, INC. Providence 1, R. I.
Branch warehouses in principal cities.
Pipe Fabrication Plants: Cranston, R. I.; Warren, Ohio.

GRINNELL
WHENEVER PIPING IS INVOLVED

View of Coty plant at Suresnes, France



Rear view of Worthington Compressors, showing Multi V-Drive aftercooler and receiver.

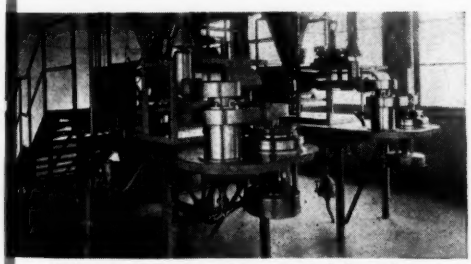
These Machines Put the Air in "Air-Spun" Face Powder

For a number of years, Coty, Inc. (Societé COTY), in its plant at Suresnes, France, has used air-actuated micronizers to provide the high degree of fineness and smoothness that characterizes Coty's "Air-Spun" face powders.

Coty pioneered in this development of supplementing mechanical methods of processing the ingredients with this method which causes the mechanically-processed materials to impinge against each other, effecting extremely minute pulverization.

Carefully metered volumes of compressed air are delivered at 95 psi to the micronizers, where directional air nozzles create intensive and diverse swirls, producing the desired pulverization.

To provide oil- and moisture-free compressed air, Coty selected Worthington compressors, 12 x 11 machines rated at 95 psi, 250 cfm, and 25 rpm, driven by 50 hp, 1200 rpm motors.



Micronizers in Coty plant. Air fed through directional nozzles causes powder particles to impinge against each other, producing minute pulverization. Particle size is controlled by rate of feed.

Special Features

In order to reduce vibration and noise to a minimum, the compressors were specially-built. Aluminum, rather than cast-iron, pistons reduced inertia and resultant unbalanced shaking forces. Placing the motor nearer the crank end of the machine brought the center of gravity into a more favorable location in respect to the foundation.

To prevent the machines from operating in synchronism for any length of time, sheave diameters were modified slightly, giving a compressor speed of 250 rpm for No. 1 unit, 245 rpm for No. 2 unit, and 240 rpm for No. 3 unit. Although two machines could at some time, be in step, synchronism would be instantaneous only. Adjacent compressors on the same center line were installed opposed, as a further compensation for unbalance.

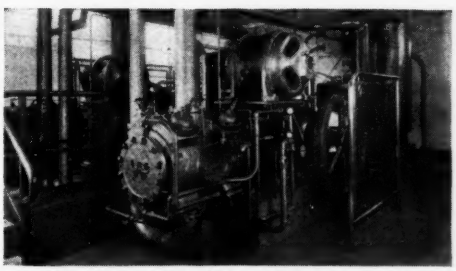
Sensitive Mercoid pressure switches, actuated by air-receiver pressure, are set for slightly different pressures so only those compressors required to meet air demands will operate. No. 1 pressure switch opens at 100 and closes at 95 psi; No. 2 pressure switch opens at 99 and closes at 94 psi; No. 3 pressure switch opens at 98 and closes at 93 psi; and No. 4 pressure switch opens at 97 and closes at 92 psi.

Timing

The timing relay, actuated by a small subsynchronous motor, provides a delay between the energizing of any two motor starters, preventing second motor from starting until the first is running with the compressor fully loaded.

The four reset pushbuttons serve as cutout switches during weekend and shutdown periods. Also, they prevent the automatic restarting of any unit after it has been automatically shut down from causes such as loss of jacket cooling water or current failure.

Each compressor has its individual aftercooler and air receiver. Aftercoolers, somewhat oversize, provide a longer cooling time to give a maximum of oil and moisture separation. An automatic moisture trap expels oil and moisture separated in the aftercooler. A second trap removes further condensation and separation occurring in the receiver. Twin mechanical oil separators are installed just beyond the air receivers. To prevent discoloration difficulties the inside of the aftercoolers and receivers are galvanized, or covered with rust-proof paint; distribution-system piping and fittings are of brass.



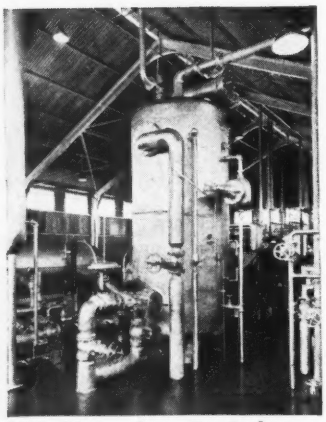
Two 12 x 11 Worthington HB Compressors which furnish air to the micronizers.

NEWS

FROM THE POWER FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

NEWS from the power front

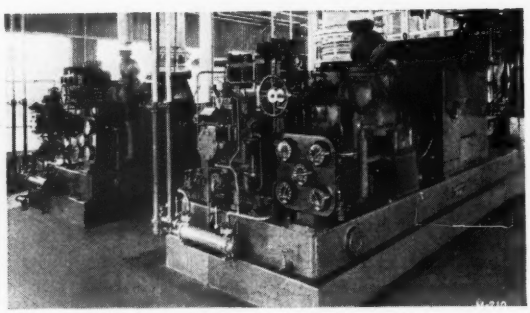


Worthington deaerating feedwater heater—90,000 lb. hr.

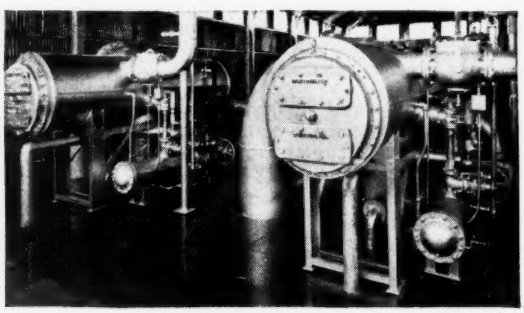
It Takes a Lot of Worthington Equipment to "Dry Out" Gas

These pictures show some of the Worthington equipment installed in The Chicago Corporation's Feazel & Kinsey gasoline plant located at Carthage, Texas, designed and built by Stearns-Roger Manufacturing Co. of Denver.

The purpose of this plant is to take the wet high-pressure gas produced from the high-pressure gas wells in the Panola County fields, and separate the water vapor from the recoverable hydrocarbon vapors consisting primarily of propane, butane, and gasoline. The residue dry gas leaving the absorbers is delivered to the pipe line for transmission and distribution.



Two 750 KW Worthington steam turbine-generator units



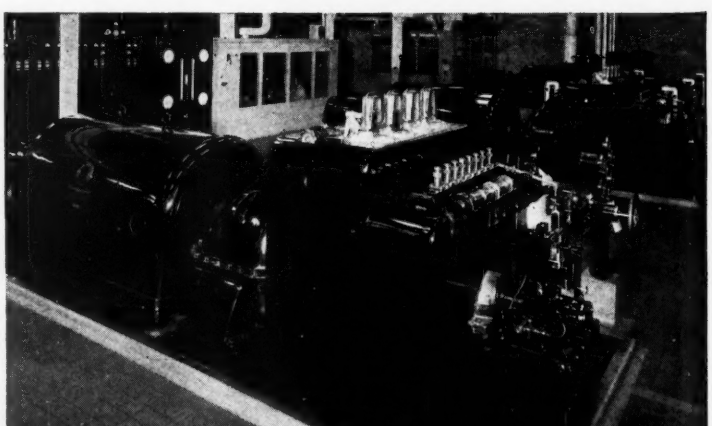
Two 800 sq. ft. Worthington surface steam condensers and condenser accessories

What Makes Willow Run Run?

Electric power for the Kaiser-Frazer plant at Willow Run, Michigan, is furnished by two Worthington 2500 kw Turbine-Generators.

These units are direct-connected, 3600 rpm, 13,800 volt, 3 phase, 60 cycle. They operate on steam at 250 lb initial pressure, 470 F total temperature, exhausted at adjustable pressures of 15-50 lb to a condenser of 27½ in. vacuum.

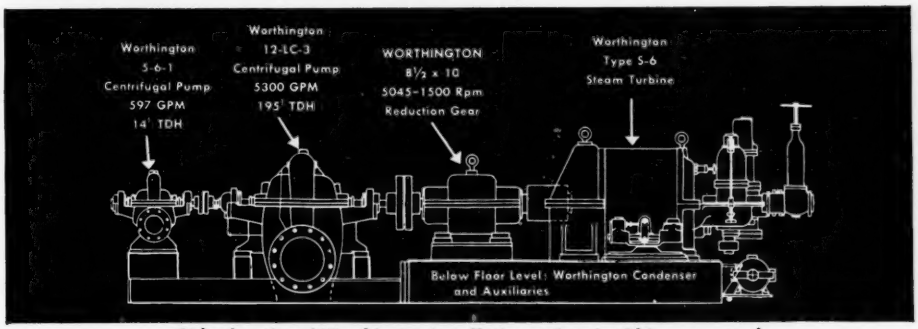
Installed in 1941, these Worthington Turbine-Generators supply both electric power and extracted steam for plant heating.



Worthington 2500 KW Turbine-Generator at Kaiser-Frazer plant, Willow Run

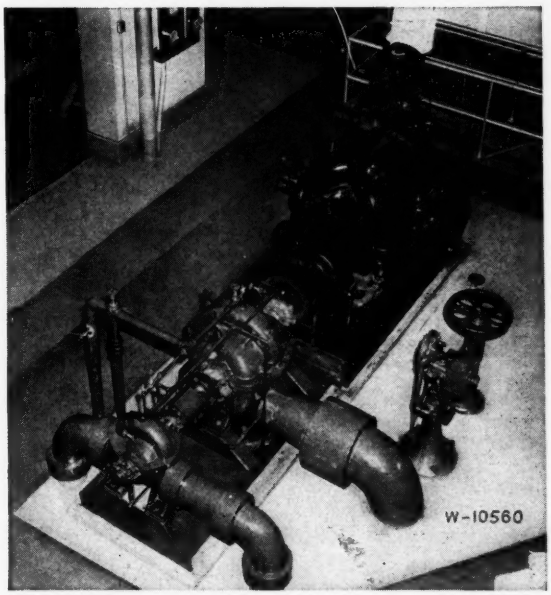
Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS



Side elevation of Worthington installation at Lorain, Ohio, water works

A Lot of Water Has Gone Through This Pump



Worthington Centrifugal Pump in water works at Lorain, Ohio

More than ten years ago, the city of Lorain, Ohio (a community of 45,000 people) installed a Worthington centrifugal pumping unit to deliver seven and one half million gallons of water per day.

H. B. Wallace, chief engineer of the water works, reported recently that this Worthington pump has operated continuously ever since with never a shutdown except for routine maintenance.

During the majority of the time the pump has handled the entire capacity load; and at various times it has been required to handle appreciable overloads.

The complete water works unit consists of a 7.5 mgd 12 in. pump that is driven by a geared steam turbine with the main pump shaft double extended for connection to the condenser circulating pump; also a surface condenser with its auxiliaries.

All elements are of Worthington manufacture, thus giving undivided responsibility for proper operation.

Springfield Purchases 3rd Worthington Turbine Generator Unit

The city of Springfield, Minnesota, has for a long time operated its own electric power plant.

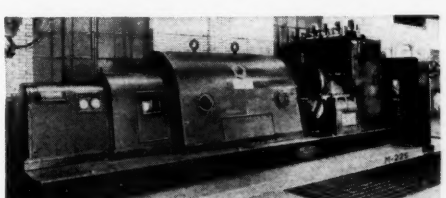
In 1895, electric power was furnished in a limited way from 5 to 10:30 P.M. each day by a 40 kw generator driven by gasoline engine. In 1902 a steam engine with 50 kw belted generator was installed. In 1915 this was replaced by a 100 kw steam engine, and the system was converted from direct current to alternating. At the same time a heating system for the business district was installed, using the exhaust steam which would otherwise be lost to atmosphere.

Further expansion came in 1923 with a 250 kw steam engine. By 1937 the electric load had so far outstripped the heating load that it became necessary to exercise economy in order to reduce cost of operation. A 750 kw Moore automatic bleeder condensing turbine was installed; it was designed for 400 lb steam pressure, 670 F temperature.

Then the necessity for adapting all the modern practices of steam plants — including higher pressure and temperature–led to the purchase of a 1000 kw Moore automatic bleeder condensing turbine.

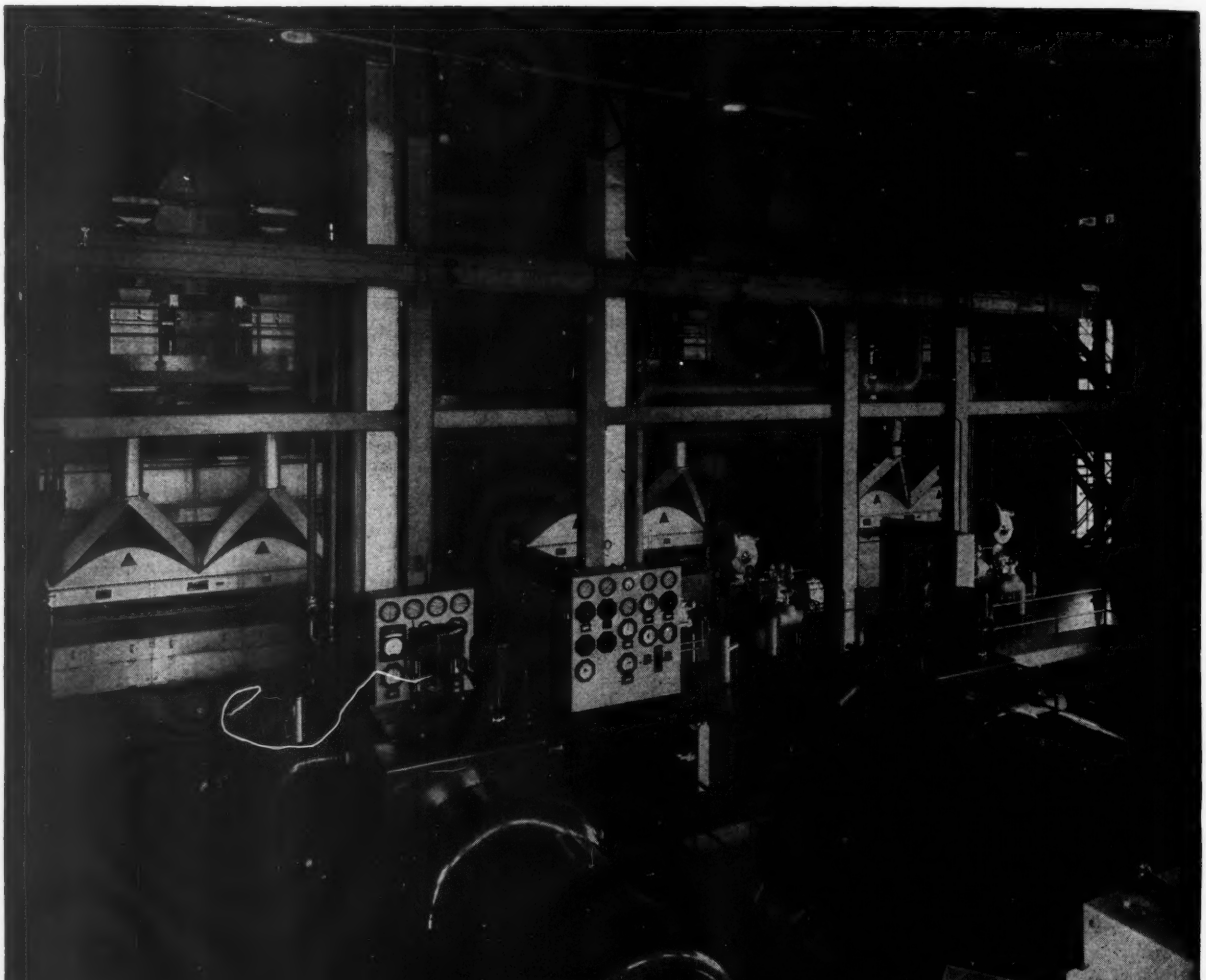
Acquisition of REA power contracts necessitated further expansion of the facilities. Last year a 2000 kw Worthington automatic extraction unit was put into operation along with a new high pressure boiler.

The plant now realizes maximum efficiency from the advantages of modern design.



Worthington 2000 kw turbine generator, City of Springfield, Minnesota

Specify Republic



A Republic combustion control system operates the three boilers in this new power plant which supplies all the steam and power for a large university. During the first year of operation this new plant provided heat for 13.0 percent more building space, generated 114.3 percent more electric power but consumed 9.86 percent less fuel.

REPUBLIC
INSTRUMENTS
AND CONTROLS

Combustion Control

TO INCREASE TODAY'S STEAM PRODUCTION

TO DECREASE TOMORROW'S STEAM COST

The installation of Republic automatic controls on your boiler (or boilers) will enable you to:—

SAVE FUEL by automatically maintaining highest combustion efficiency.

INCREASE STEAM OUTPUT by operating the boilers at test efficiency 24 hr. a day, 7 days a week.

CONSERVE MANPOWER by automatically performing the many routine repetitive adjustments.

REDUCE OUTAGES by maintaining uniform operating conditions and thereby prevent the chain-of-event type of trouble that frequently developes as a result of incorrect boiler operation.

An automatic combustion control system, as designed and built by Republic, will help you meet today's need for more steam and tomorrow's need for lower steam costs.

The Republic combustion control is a unified system controlling simultaneously, in measured quantities and in correct proportions, the fuel and air input to the boiler. It increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency. It not only checks operation but automatically makes necessary corrections of individual factors before faulty operation has a chance to develop.

The difference between such a control and an assembly of uncoordinated regulating devices is comparatively small in equipment but great in principle. Merely to provide automatic operation of a number of individual device is not enough.

CHECK THESE FEATURES

Built into the Republic combustion control systems are many features that enable it to fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of everyday operation.

Check the following features against your list of "musts" for a perfect combustion control system.

CENTRALIZED CONTROL: The operation and control of the boiler or boilers is centralized at the master controller.

FUEL-AIR RATIO INDICATOR: The master controller is provided with mercury manometers which indicate the measured fuel and air inputs to the boiler and the fuel-air ratio.

FUEL-AIR RATIO ADJUSTMENT: A handwheel on the front of the master control panel provides a convenient means for adjusting the fuel-air ratio.

ALL BOILER RATINGS: Maintains proper fuel-air ratio over the entire range of boiler ratings.

CONSTANT STEAM PRESSURE: Maintains the plant steam pressure within narrow limits of variation by proportioning the fuel and air inputs to the load.

LOAD DISTRIBUTION: Provides a means of distributing the load among the boilers as desired.

MANUAL CONTROL: Boiler ratings can be controlled manually by a handwheel located on the front of the panel.

Find out about Republic control systems. One of our engineers will be glad to consult with you at any time. Write us today.

Republic Flow Meters Co.

2240 Diversey Parkway • Chicago 47, Illinois

In YOUR industry there's a plant with your problems now using VU

You may feel that your steam generating requirements are unusual, or peculiar to your industry. Perhaps you are in the textile industry, a paper plant, a mine, or a brewery. You may be generating steam with pulverized coal for a utility station . . . or even burning crushed cane to produce process steam for a sugar refinery. Your needs may be as little as 15,000 lb of steam per hr, or exceed 300,000.

Yet, paralleling your problems, there is some similar plant profiting from VU performance. For, in every basic industry, the VU Unit has met the supreme test of use. Throughout the United States and Canada, Latin America and abroad, the VU has been selected for installations with an aggregate capacity of more than 80,000,000 lb of steam per hr. Spot check, in your own industry, the experience of others . . . see how the versatile VU Unit adapts itself to your *special* needs. B239

DOESN'T THIS DESCRIBE THE UNIT YOU WANT?

Adaptable — The VU Unit is adaptable to limited space conditions, to the use of any fuel or method of firing, and to widely varying requirements of load, pressure and temperature.

Efficient — The VU Unit operates at efficiencies up to 88 per cent, due to a basic design which combines efficient combustion, maximum exposure of evaporative surface to radiant heat, cross-travel of gases in tube banks, and concentration of large heating surface in the last bank.

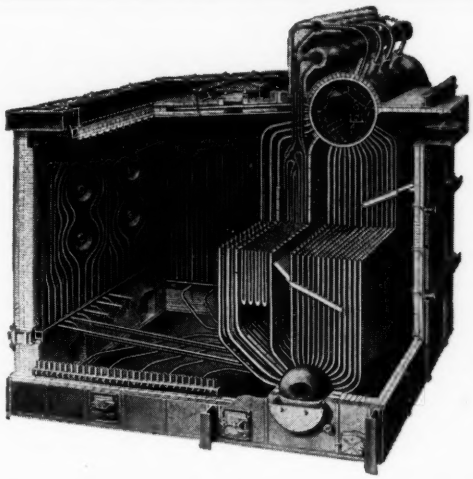
Flexible — The VU Unit may be operated over a wide range of output, is responsive to extreme fluctuation in load, and is well adapted to automatic combustion control.

Symmetrical — Symmetrical design of longitudinal sections eliminates lazy tubes, since each section has the same furnace volume, same evaporative surface, same amount of water, and produces the same amount of steam. Moreover, the uniform release of steam along the entire length of the drum eliminates surging water level and periodic carry-over of water slugs.

Standardized — Details, as well as general design, are standardized — a safeguard against errors or oversights in manufacture and installation. And the economies of standardized design are reflected in first cost, since much of the engineering of individual units is avoided.

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

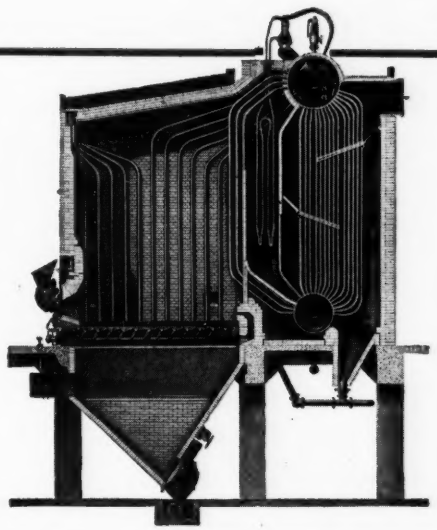


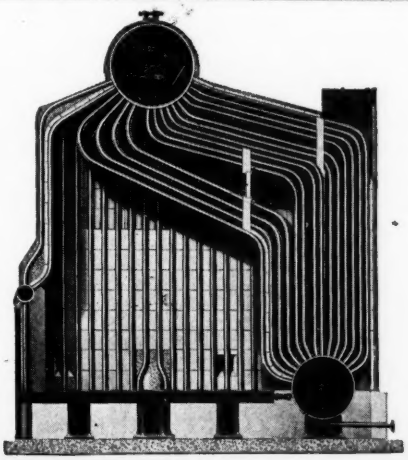
Type VU Steam Generator (for the higher capacity range)

This unit, the original VU design, may be fired by pulverized coal, oil or gas, or any combination of these fuels. Available for capacities up to 350,000 lb of steam per hr, pressures up to 1000 psi and steam temperatures up to 900 F, or higher. Furnace bottom may be as shown or may be of hopper type. Economizer or air heater surface may be added.

Type VU Steam Generator (for the middle capacity range)

In this VU design, shown equipped with a C-E Spreader Stoker, the furnace proportions and arrangement of water wall surfaces may be adapted for firing by any type of mechanical stoker. Design is also adaptable for firing by oil or gas. Economizer or air heater surface may be added. Approximate capacity range 25,000 to 100,000, or more, lb per hr.





C-E Package Boiler (for the lower capacity range)

This youngest member of the VU family is designed for industrial load conditions and particularly for plants having small operating and maintenance forces. Capacities range from about 15,000 to 50,000 lb per hr. Firing may be by spreader stoker, single-retort underfeed stoker, oil or gas burners. Any of these methods may be substituted for any other, should fuel market conditions make this desirable.

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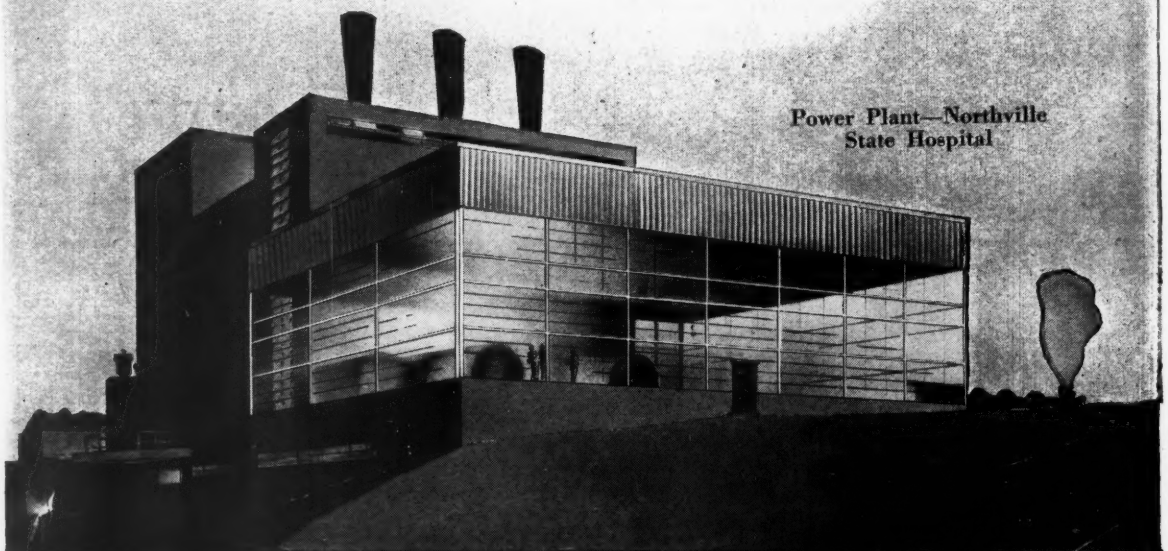
Under the guiding hand of ADRIAN N. LANGUIS, *Director of Buildings and Construction, the State of Michigan has embarked on an extensive construction program. As modern and practical as the power plants in which they are installed, Wickes 3-drum Boiler Units have been purchased for power plants at Northville State Hospital and Michigan Reformatory (Ionia), engineered by E. R. Little Co., Inc., Detroit, Mich.; the Kalamazoo State Hospital, by Fargo Engineering Co., Jackson, Mich.; the Traverse City State Hospital and Michigan State Sanatorium (Howell) by Allied Engineers, Inc., Detroit, Mich.; the Northern Michigan College of Education, (Marquette), by Cummins and Barnard, Ann Arbor, Mich.; and Ionia State Hospital, by Beyster Corporation, Detroit, Mich. Scores of Wickes boilers are in successful operation today in state institutions, municipalities and federal projects. Wickes can fill your requirements for boiler units ranging up to 275,000 lbs. steam per hour and 850 p.s.i. Write today.*



Power Plant—Northville State Hospital

THE WICKES

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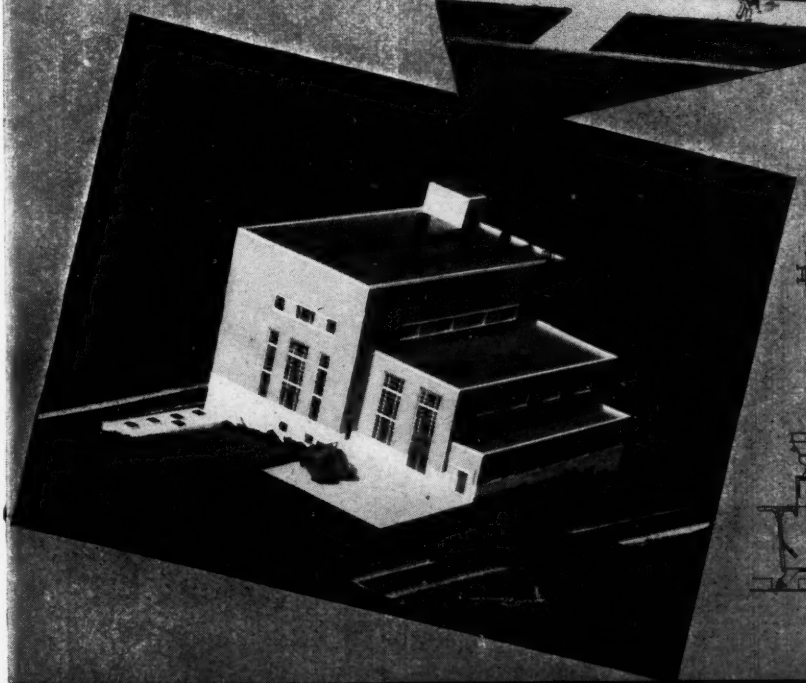
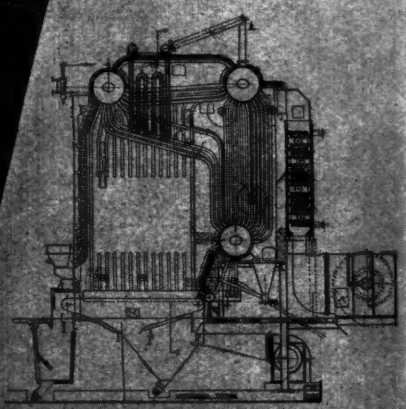
BUILDS FOR THE PRESENT AND CONSTRUCTION PROGRAM

Two Modern Steam Generation Plants

Right: Michigan State Sanatorium, Howell, Mich.

Below: Traverse City State Hospital.





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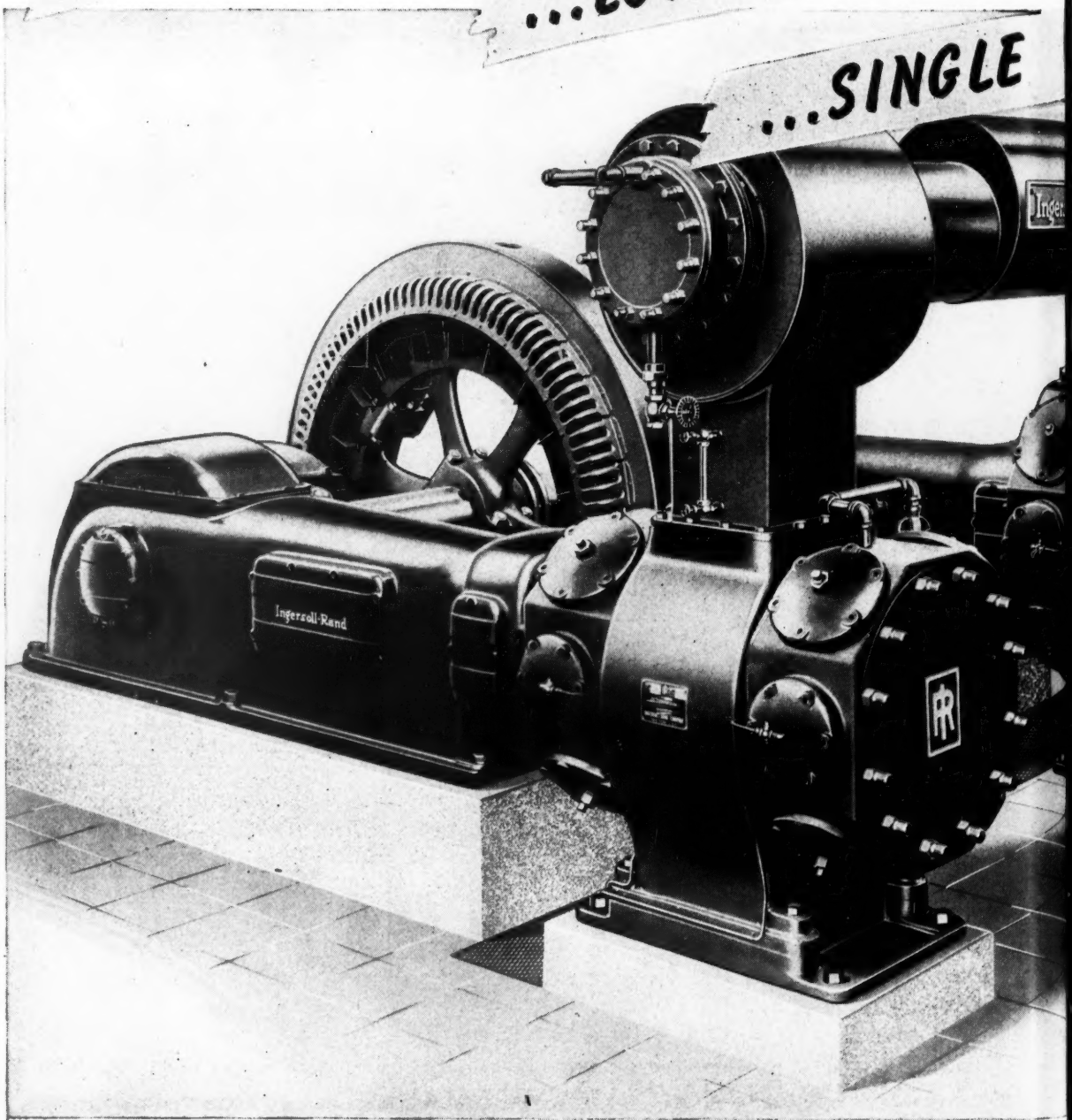

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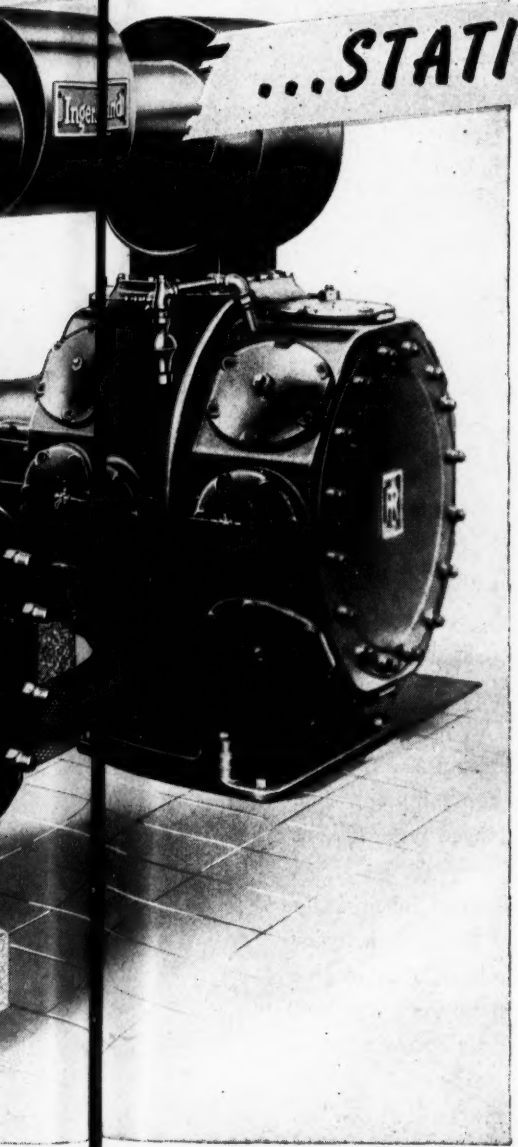
and HIGH PRESSURE -STAGE and MULTIPLE-STAGE ...STATIONARY and PORTABLE



Regardless of size or classification, assured, uninterrupted performance of air compressors depends largely on lubrication. High stability and oxidation resistance are necessary qualities of a compressor lubricant to protect against the problems of carbon formation and sticking valves.

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Consider the figures

When you buy a combustion control system, only the first cost is in the bid—and you have to look *beyond* first cost to know which system is your "best buy."

Let's take the matter of depreciation, for example. Not depreciation as an arbitrary figure for the convenience of the accounting department, but as a measure of the useful and efficient life of the equipment. The ruggedly built components of the Hagan system last as long as the boiler—and longer.

How much will maintenance cost you? Surprisingly little—with Hagan. Simplicity of design is a major factor here, and Hagan equipment is designed to give minimum opportunity for wear, to use the fewest possible parts which may get out of order, to make maintenance easy. As one old-timer put it: "You don't have to be no watchmaker to work on Hagan controls."

that aren't in the bid——

All of these figures on costs, however, are far less important than figures on fuel. Take for example a 100,000 lb./hr. boiler, running 24 hours a day, 300 days a year. Coal consumption will be roughly 5 tons an hour. At $6.00 a ton, your fuel bill will be $720.00 a day, $216,000 a year. Such a boiler will consume a million dollars worth of fuel in less than five years—and five years is only a fraction of the useful life of boiler and control.

Figures like this make it clear that the really important thing is not the cost of the control system, but what that system will do to your fuel costs—and that brings you right back to Hagan.

Hagan equipment lasts as long as the boiler, stays accurate, and gives you dependable, trouble-free service as long as it lasts.

Our engineers are at your service.

Hagan Corporation, Hagan Bldg., Pittsburgh 30, Pa.

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BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
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GP

Going Places!

Yes, Garlock is going places with sheet packings because one of the many Garlock sheet packings answers *every* requirement efficiently and economically. Three widely used Garlock gasketing materials are:

GARLOCK 7021 Compressed Asbestos Sheet—exceptionally strong and tough. Gives superior service against gasoline, oil, gas or steam at high temperatures and extreme pressures.

GARLOCK 22 Red Rubber Sheet Packing—finest quality. Specially recommended for hot or cold water and low pressure steam joints.

GARLOCK 660 Cork-Fibre Sheet Packing combines granulated cork and vegetable fibre into a strong compressible sheet; treated with an oil resistant binder. An ideal gasketing material for oils and solvents at temperatures up to 212° F.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
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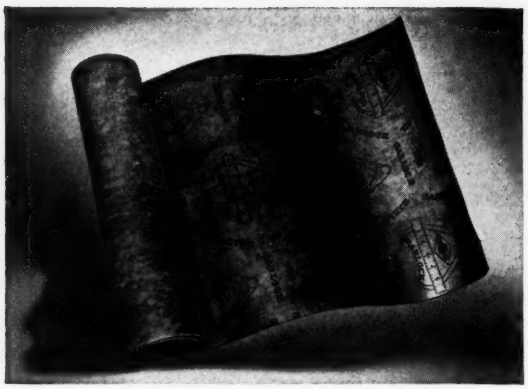
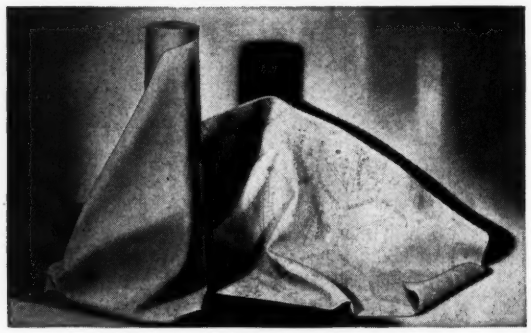
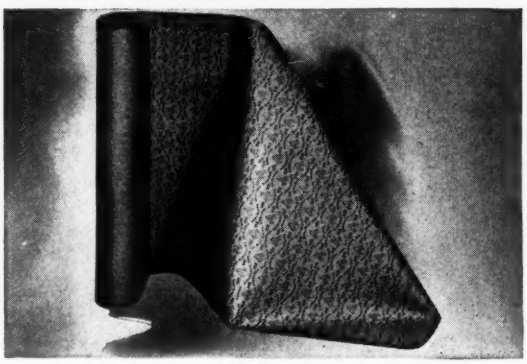


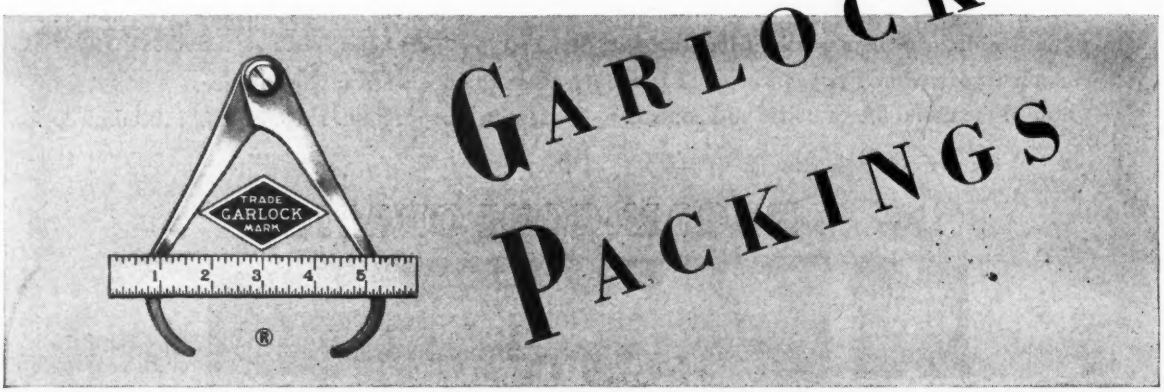
GARLOCK 7021 Compressed Asbestos Sheet Packing



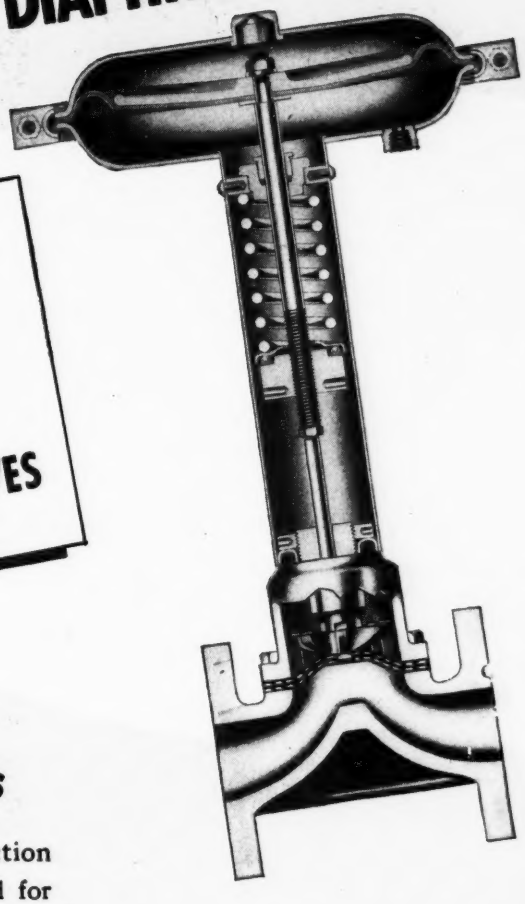
GARLOCK 22 Red Rubber Sheet Packing



GARLOCK 660 Cork-Fibre Sheet Packing



REVERSE-ACTION DIAPHRAGM MOTORS



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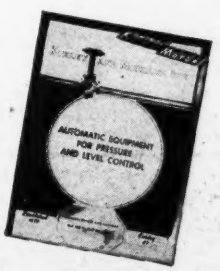

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NORTH BERGEN N.J.

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HELPFUL BULLETINS

BOILERS, STOKERS, ACCESSORIES

1 **Stokers**—This 4 page bulletin is the half a century celebration bulletin. Depicted are the various plants the firm has occupied and all the different types of stokers, both in equipment photos and actual installation photos, that the company makes. Detroit Stoker Co.

2 **Steam Generator**—Package Type - A 4 page bulletin describing the package steam generator and other boilers made by this firm. Boiler feed pumps and condensate return systems are also described. All models are illustrated which are described. Sizes up to 110 hp. C.. H. Dutton Co.

3 **Ramfeed Stokers**—Bulletin 203, 12 pages, explains and depicts the construction, operation, and furnaces to which this stoker is suitable. Phantom flow views, dimensional drawings, parts photos, and hook-up of the synchronized combustion control in sketches are given. Canton Stoker Corp.

4 **Spray Pond Equipment**—Bulletin 13-1, 4 pages, presents the equipment made by this firm for use in cooling spray ponds. Layout plan of equipment in a pond and steam tables for steam condenser work are given. Binks Mfg. Co.

5 **Choosing Heating Equipment**—This 12 page bulletin explains the different types of equipment and the types of applications they are suitable to for burning anthracite. Several types of stokers are illustrated and notes presented on their merits with anthracite. Anthracite Institute.

6 **Electrostatic Precipitator**—This eight page bulletin announces the entrance of this firm into the business of making precipitators. The two types made are pictured with explanatory text. Specification sheets are provided for information since each application requires a special precipitator. Shops Div., Koppers Co., Inc.

TURBINES, ENGINES

7 **Multi-Stage Turbines**—Bulletin 1961, 28 pages, describes and illustrates the Type S with oil relay and governor. Detailed photos and sketches show parts of shroud, wheels, nozzles, bearing and packing glands, governor, overspeed trip, lubrication system. A listing is given of drives it is suitable for, variation of designs for condensing, non-condensing, extraction, mixed pressure and others. Worthington Pump and Machinery Corp.

8 **Gasoline and Diesel Power Units**—Bulletin A-293-JJ, 16 pages, describes and illustrates the power units made by this firm for almost any set-up where an engine can be used. Information as to design, construction, and operations is given. International Harvester Co.

ELECTRICAL

9 **Guide for Electric Motor Selection**—Bulletin No. 51B6052J, 12 pages, provides detailed specifications covering squirrel-cage induction motors and application data, range of sizes and speed torque curves on synchronous, wound rotor and d c motors. Allis-Chalmers Mfg., Co.

10 **Selenium Rectifiers**—This 10 page catalog presents the latest information on these rectifiers made by this firm. Low voltage, remote controls, self-contained, and laboratory models are described and the principal data given. Notes are added on other types they make. Richardson-Allen Corp.

11 **Insulated Wires, Cables and Cords**—Catalog and Handbook No. 10-F, 98 pages, is a tab indexed handbook for selecting insulated conductors. Indexed are power and control, lighting, apparatus, switchboards, electronics, magnets. Book is really complete. Tables of sizes, capacities, uses, wrapping, and a chart for selecting size for circuit length, load and voltage drop are given. Rockbestos Products Corp.

PUMPS

12 **Controlled Volume Chemical Pumps**—Bulletin No. 484, 4 pages, describes and explains the construction and operation of these pumps. Capacity/pressure chart is provided, cutaway drawings depict construction. Complete hook-up diagram is given for a typical installation. Milton Roy Co.

13 **Liquor Pumps**—Bulletin 245, 6 pages, depicts and describes a line of centrifugal liquor pumps for process industries. Sectional views in the bulletin show mechanical features and text covers the technical details. Warren Steam Pump Co., Inc.

14 **Non-Pulsation Pumping**—Book No. 22, 16 pages, presents in photos, dimensional drawings, and text with tables, the rotor pump made by this firm which is claimed to pump without pulsation. A long list of the materials which it will pump is supplied. Moyno Pump Div., Robbins & Myers, Inc.

15 **Automatic Proportioning Control Pumps**—Bulletin PKA-47, 4 pages, contains application information on the proportioning control pumps. Hook-up diagrams make up the illustrations. The method used for control is explained and claimed advantages stated. Hills-McCanna Co.

16 **Centrifugal Pumps**—Bulletin W-305-B1, 12 pages, presents information for selecting a pump. Types CN and CNE in 3 sizes are explained with specifications, rating charts, installation data, dimensions, and photos of the complete units. Worthington Pump and Machinery Corp.

17 **Single Stage Centrifugal Pumps**—Bulletin No. 83-29, 28 pages, describes and illustrates outstanding features of design and construction with a listing of pump ratings and essential dimensions. Catalog can be of aid in selecting required pump. De Laval Steam Turbine Co.

TREATMENTS

18 **Steam Heating System Treatment**—This bulletin of 4 pages describes treatment and equipment for cleaning steam heating and processing lines. Photos and drawings are given to show how it works and its application. Pressure-Jet Systems.

19 **Processing of Water**—This is a 12 page technical treatise on the electronic method of processing of water and its associated data. It contains such discussions as the fundamental behavior of water solutions, simple scale formation, chemical reactions in solutions, reversible reactions and equilibrium, removal of old scale, acids and bases—ph values, colloids, corrosion control, galvanic cells, oxygen corrosion. Electromatic Engineering Co., Inc.

MATERIALS HANDLING

20 **Hydraulic Materials Handling Systems**—Catalog No. 448, 16 pages, describes and illustrates with photos of parts and assemblies, sketches of possible hookups and controls, the several kinds of machinery for handling dusts, fly-ash, and other flake and granular materials. Allen-Sherman-Hoff Co.

21 **Overhead Handling Equipment**—Bulletin C-1, 58 pages, presents the story, pictorially, of all the many applications the overhead handling equipment of this maker of such equipment finds in modern industry. Detailed points of construction and operation, and various adaptations with auxiliaries are discussed and illustrated. American Monorail Co.

22 **Belt Conveyors**—Catalog 785, 160 pages, is virtually a handbook on the subject of belt conveyors. The standard conveyors made by this firm are described and illustrated with application photos as well as tables and charts. These standard units have been indexed. A line of anti-friction idlers is treated, as are other necessary items of equipment for use with conveyors. Much engineering data for figuring installations is given. Jeffrey Mfg. Co.

MECHANICAL POWER TRANSMISSION

23 **Small, Fluid, Variable Speed Transmissions**—Bulletin 67110, 8 pages, illustrates and describes this line of transmissions up to 3 hp. Also given is information on four styles of manual, hydraulic, and hydro-electric controls devices. Photos and dimensional drawings with tables are given for each type. Oilgear Co.

24 **Adjustable Diameter Wedgbelt Drives**—Bulletin WRB-48, 4 pages, presents the story of the variable diameter pulleys and how to select the right drive for a particular job. Tables for use in selection are provided. Dimensional drawings also included to provide data. American Pulley Co.

25 **Flexible Couplings**—Index 2197, 4 pages, contains data on all the flexible couplings for direct connected drives handled by this firm. All couplings are pictured and pertinent information about them included. A table shows how to select the right size coupling. B. F. Goodrich Co.

PIPING AND ACCESSORIES

26 **Molded Valve Packing**—Catalog Section 12-R, 4 pages, describes and gives full details including prices for each set and size and pressure class. Packing is claimed to be heat resisting. Edward Valves, Inc.

27 **Draining and Venting Drying Rolls**—Technical Bulletin No. 2, 8 pages, describes this company's system for draining and venting rotating cylinders. Subjects discussed include: causes of inefficiency, wastage of steam, output and cost, waterlogging, steam locking, steam operated suction dryers. Saco Co., Inc.

28 **Air and Gas Pipe Line Filters**—Bulletin No. B-1A, 8 pages, explains and depicts the construction and application of these filters to various services. Photos of applications in use are given as are phantom views to show how the filters operate. Dollinger Corp.

29 **Surface Condensers**—Bulletin C-9, 16 pages, includes data on these condensers, steam jet ejectors, duplex strainers, air leakage meters, as well as pressure-temperature conversion table, chart for determining logarithmic mean temperature difference and condenser formulas. Elliott Co.

30 **Gas Scrubbers and Coolers**—Bulletin No. H-203, 4 pages, utilizes flow diagrams, phantom views, drawings, and photos to show the construction, operation, and application of these gas scrubbers and coolers. Peabody Engineering Corp.

September, 1948

POWER GENERATION
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TOOLS

31 **Metallizing gun**—Bulletin 50A, 4 pages, presents the type 2E metallizing gun made by this firm which they say is the best all-purpose gun. The gun and its applications are discussed and pictured. The correct type and set-up of tanks, wire and gun mounting is shown. Metallizing Engineering Co., Inc.

32 **Soft Tube Working Tools**—Form 347, 16 pages, pocket size, contains brief descriptions and illustrations of the different tools made by this firm for working brass and copper tubing. Sizes and prices are given for tool and accessories. Imperial Brass Mfg. Co.

33 **Air and Water Driven Tube Cleaners**—Bulletin Y26, 4 pages, presents with exploded views the construction and operation of these cleaners for boiler tubes and general service. Tables give sizes available for tube sizes, both straight and curved. Lagonda Div., Elliott Co.

34 **Boiler Tube Expanders**—Bulletin E-2, 6 pages, presents the various designs of tube expanders, sizes, tube size they fit, shipping weight, and prices. Richard Dudgeon, Inc.

35 **Puller for Larger Pulleys**—Form No. 100, 4 pages, describes and illustrates with photos and sketches the adaptability of these pullers to many jobs. Shows how one man can operate the unit. Table of capacities is given. Industrial Engineering Equipment Co.

HEATING UNITS

36 **Space Heaters**—Bulletin No. 300, 8 pages, depicts with construction and application photos and drawings the tall unit heater for spot locating in plant. Small floor space necessary is highlighted feature. Thermobloc Div., Prat-Daniel Corp.

37 **Vertical Flow Unit Heaters**—Catalog No. 2648, 16 pages, presents the line of vertical flow unit heaters in various sizes for either steam or hot water. Full selection information given. Young Radiator Co.

38 **Extended Surface Radiation**—Bulletin B 1550B, 8 pages, describes and illustrates with cutaway drawings, phantom views, assembly photos, piping diagrams, and dimensional drawings the fin type of extended surface radiators made by this firm. Ratings and dimensions are given. Warren Webster & Co.

FANS, BLOWERS, COMPRESSORS

39 **Centrifugal Blowers and Exhausters**—Bulletin B-5, 20 pages, describes and explains the construction of these blowers and exhausters. Considerable engineering data for use in selection of these units is provided. Order data and general technical information is also provided. Allen Billmyre Div., Lamson Corp.

40 **Departmental Air Compressors**—Bulletin E-215-B, 4 pages, is an explanation presented in the form of an article on the subject of the use of departmental air compressors. Last page describes the several types and models of compressors this firm makes. Table gives specifications of compressors. Davey Compressor Co.

INSTRUMENTS AND CONTROLS

41 **Liquid Level Indicators**—Bulletin WG-1822, contains the latest information on the new addition to this line of liquid level indicators, and the control unit for remote signalling and controlling devices. Phantom and cross-sectional views show the construction and operation. Many photos depict the units and their application. Yarnall-Waring Co.

42 **Boiler Feed Water Level Control**—Bulletin No. 483, 4 pages, describes the installation and operation of the controls made by this company in a gas plant. Photos and drawings show how and where the controls are installed. Northern Equipment Co.

43 **Indicating and Recording Instruments**—Form No. 1301, 12 pages, presents several different instruments made by this firm. Included are: High and slow speed chart meters, speed recorders, speed indicators, resistance recorders, boiler water concentration recorders, time recorders, relays with indicators. Esterline-Angus Co.

44 **Chemical Treatment Feeders**—Bulletin SAN-1, 8 pages, describes and explains the various feeders for controlling the feeding of all types of treatments, compounds, and chemicals. Some of the applications to which system is suitable are given. Proportioneers, Inc.

45 **Gage Valves, Inserts Units, Glasses**—Bulletin X, 4 pages, presents the line of gage glasses and auxiliaries needed that are made by this firm. All the various sizes, pressure capacities, number of sections, and the weights are given. Ernst Water Column & Gage Co.

46 **Electric Instruments**—Bulletin GEC-227, 24 pages, presents the wide variety of instruments for indicating, recording, timing that are made by this firm. Explanations, specifications and photos are provided for instruments described. Apparatus Dep't., General Electric Co.

47 **Speed Control for Boiler Draft Fans**—Bulletin No. 4400-TEC-1078, 20 pages, discusses principles of operation with graphs, diagrams, and installation photos. Device is an electronic control. Electric Machinery Mfg. Co.

48 **Electrical Cabinet Door Switches**—Data Sheet No. 45, describes and explains the principles of operation. Switch is set so that when the door of the cabinet is opened the current is automatically shut off. Micro Switch Corp.

49 **Mechanical Flow Meters**—Bulletin 2M48, 12 pages, describes and illustrates the flow meters made by this firm. Photos, diagrams, and data on dimensions and capacities are given. A flow diagram helps the explanation. Component parts photos show important parts. Hagan Corp.

50 **Flow and Indicating Meters for Fluids**—Bulletin No. 301-B, 40 pages, is divided into 10 sections on: flow mechanisms, primary elements, integrators, auxiliary recorders, accessories, and installation features. All are illustrated with photos, diagrams, and drawings, to explain the construction and operation. Bailey Meter Co.

51 **Water Flow Measuring Equipment**—Bulletin 310, 20 pages, describes and illustrates with photos, cutaway sections, flow diagrams, and possible application sketches the equipment made by this firm. Given are: typical meter locations, pressure loss curves, specifications. Prices are listed. R. W. Sparling.

52 **Float Switches**—Bulletin 2050, 2 pages, describes and illustrates with photos, drawings of operating arrangements, and sketches showing types of mountings, and float switches for closed tank operation. Automatic Control Co.

53 **Electronic Servo Systems**—This bulletin contains ten sheets of information. Each sheet describes and pictures with diagrams a servo system as made by this firm. General notes as to type, style, power required or exerted, suitable applications, and other information is provided. Askania Regulator Co.

PROPERTY MAINTENANCE

54 **Floor Safety**—This 8 page bulletin explains the hazards of slippery floors and proceeds to explain how the firm's products are claimed to eliminate the hazard. Numerous sketches to highlight the text and show products. Walter G. Legge Co., Inc.

55 **Repairing Wet, Rutted, Floors**—This 6 page bulletin describes the floor repair made by this firm and shows with installation photos actual types of industries in which it is in use. A sample offer is made in the bulletin. Stonhard Co.

56 **Metal Roofing**—Bulletin of 24 pages tells how destructive forces can give roofing troubles and early start and increase repair bills. Full data is contained herein on a new soft-temper Monel roofing sheet. International Nickel Co., Inc.

57 **Acid and Alkali Resistant Resin Coating**—Bulletin No. 24, 4 pages explains in detail the advantages of this coating for certain uses. Company also list the applications for which it is not suitable. Application instructions are provided as is general data. Nukem Products Corp.

58 **Roof Repair Material**—Bulletin 25M, is a six page folder that describes and illustrates with photos and sketches the product for repairing roofs made by this company. Coverage tables for various types of roofs are given. Flexrock Co.

59 **Safety Flooring**—Bulletin S-F16 4 pages, describes briefly but illustrates plentifully with application photos the use of the abrasive strips this firm makes to be applied to spots needing safe footing. Available in four colors. Sample supplied. Minnesota Mining & Mfg. Co.

60 **Aluminum Roof Coating**—This four page folder explains the aluminum roof coating made by this firm. The claimed advantages are stated. Liberty Chemical Products Co.

61 **Paint for Power Plants**—Bulletin No. 7, 10 pages, presents charted guides for selecting the proper paint for a particular spot and temperature or wear problem. In this bulletin problems peculiar to power plants are taken into consideration. American-Marietta Co.

62 **Heat Insulating Block**—Bulletin KH1-485, 4 pages, describes the properties and merits of the heat insulating block made by this company. Table of physical characteristics and one of standard sizes are given with a page of charts on heat loss, surface temperatures, and efficiencies. American Structural Products Co.

MISCELLANEOUS

63 **Towel Service**—This double sheet explains a wiping cloth service and illustrates some of the jobs for which it is suitable. Sheet explains that towels are not purchased but merely rented. Kex National Service.

64 **Corrosion Resisting Alloys**—Bulletin 114, 8 pages, includes much information on the alloys, Chlorimet 2 and 3. Particular attention is given to its use for sulfuric and hydrochloric acids, and salt solutions. Many charts are included on corrosion resistance tests. Duriron Co., Inc.

65 **Odor Control** — Form 7279, 12 page pocket booklet, describes and explains the function and operation of the two products made by this firm for cleaning, disinfecting, and deodorizing. Listed are the industries for which the products are suitable. Many photos depict the products use in various industries. Oakite Products, Inc.

66 **Graphitic Iron Piston Rings** — Catalog 470, 36 pages, explains in detail the claimed advantages of these rings. Tables of sizes, composition, details of construction, and specifications are given. Engineering data tables of general nature are given. C. Lee Cook Mfg. Co., Inc.

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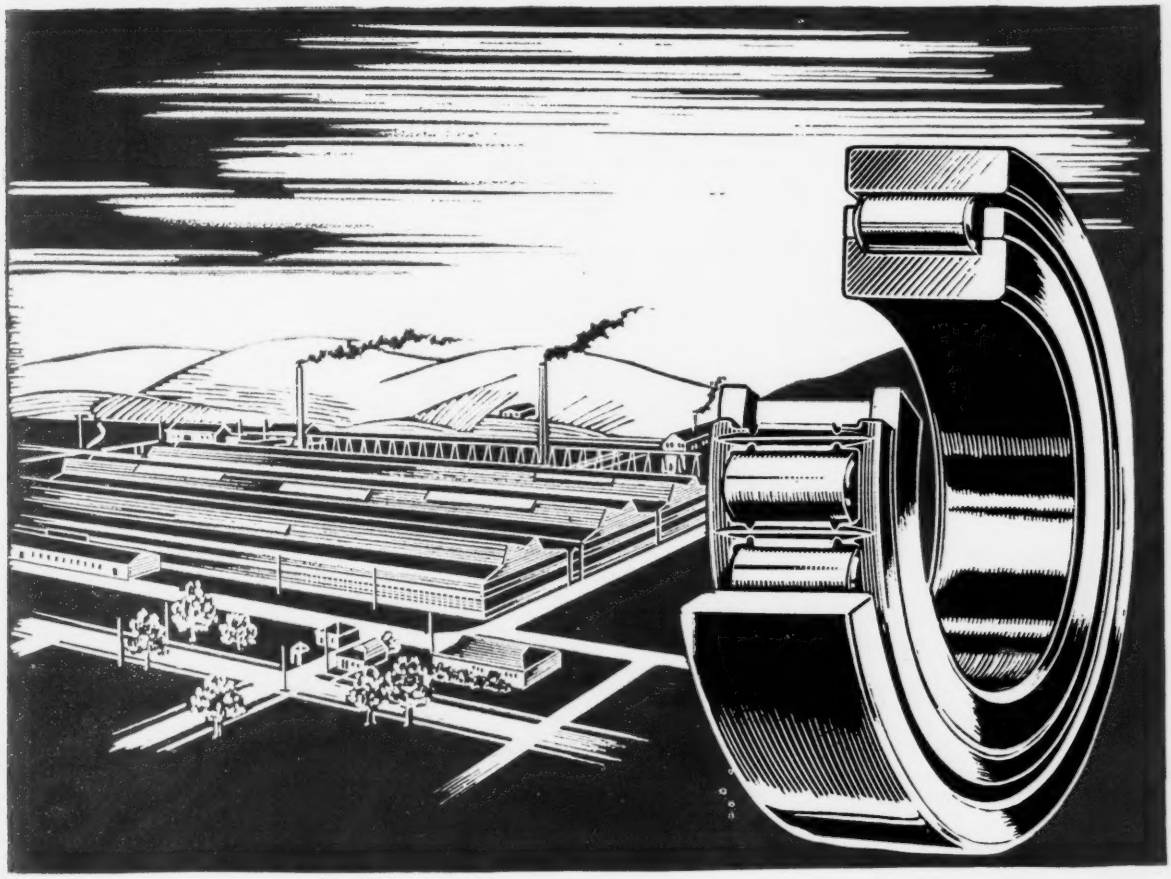

Tycol Acylkup Greases perform better because:

. . . *Tycol Acylkup Greases* contain paraffine base cylinder oil, thus assuring greater load carrying capacity and a strong "film of protection."

. . . *Tycol Acylkup Greases* are water-repellent and blended with the finest calcium soap, enough to make every application "stay put" at all times.

. . . *Tycol Acylkup Greases* have a smooth, non-fibrous structure that permits easier application in grease guns and central lubricating systems.

. . . *Tycol Acylkup Greases* safeguard precision anti-friction bearings and heavily loaded gears alike . . . *save* by standardizing on Tycol!

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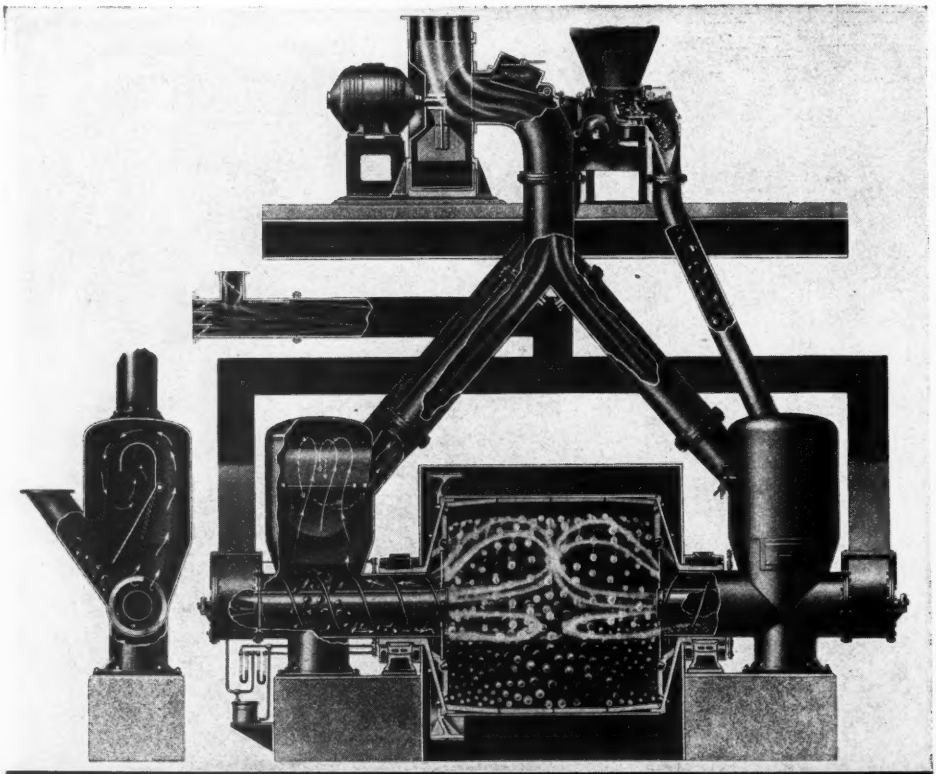
The FW Ball Mill provides



Sectional view of the FW ball mill pulverizer. The ball mill provides one of the most effective methods of pulverizing hard or abrasive fuels. This ball mill pulverizer, developed by FW, incorporates a high degree of efficiency, availability, and economical operation.

Outstanding Features

1. Large Reserve Capacity
2. High Availability — Low Maintenance
3. Constant Fineness
4. Successful Installations for Pulverizing
   - a. Anthracite Coal
   - b. Bituminous Coal
   - c. Coke Breeze
   - d. Lignite
   - e. Petroleum Coke
5. Systems with All Component Parts
6. 50 Years Background

constant fineness of pulverization

3

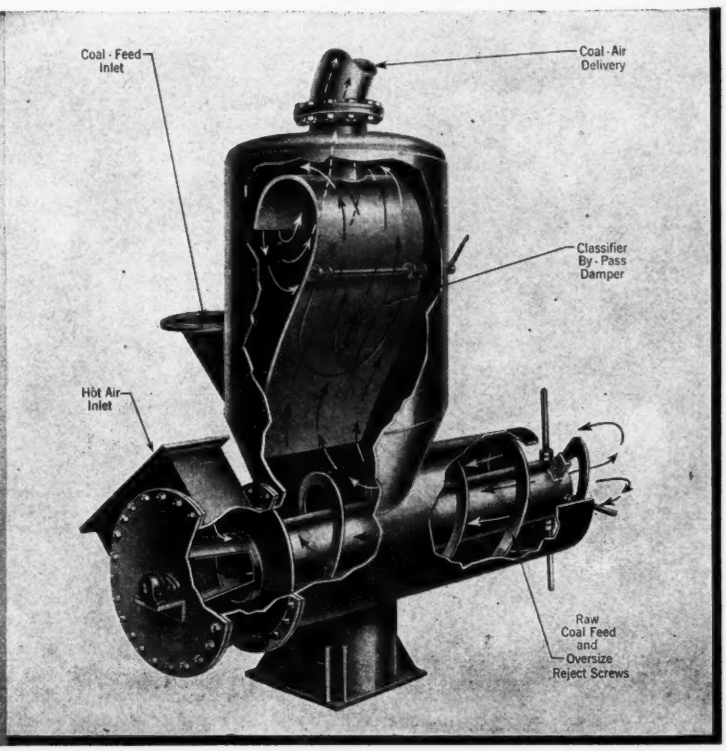
Regardless of its length of service, the FW Ball Mill—with a given coal and under uniform conditions—pulverizes fuel to a constant fineness. As the forged steel balls wear, they are replaced by the addition of small quantities at selected intervals while the mill is in service, thus maintaining the pulverizing medium at peak efficiency. Because of this, the FW Ball Mill has a much higher availability than other mills which must shut down frequently for replacement of worn parts.

Decided advantages of constant fineness of pulverization are:

Uniform Combustion • Reduced Slagging • Higher Sustained Annual Boiler Efficiency—Reduced Carbon Loss.

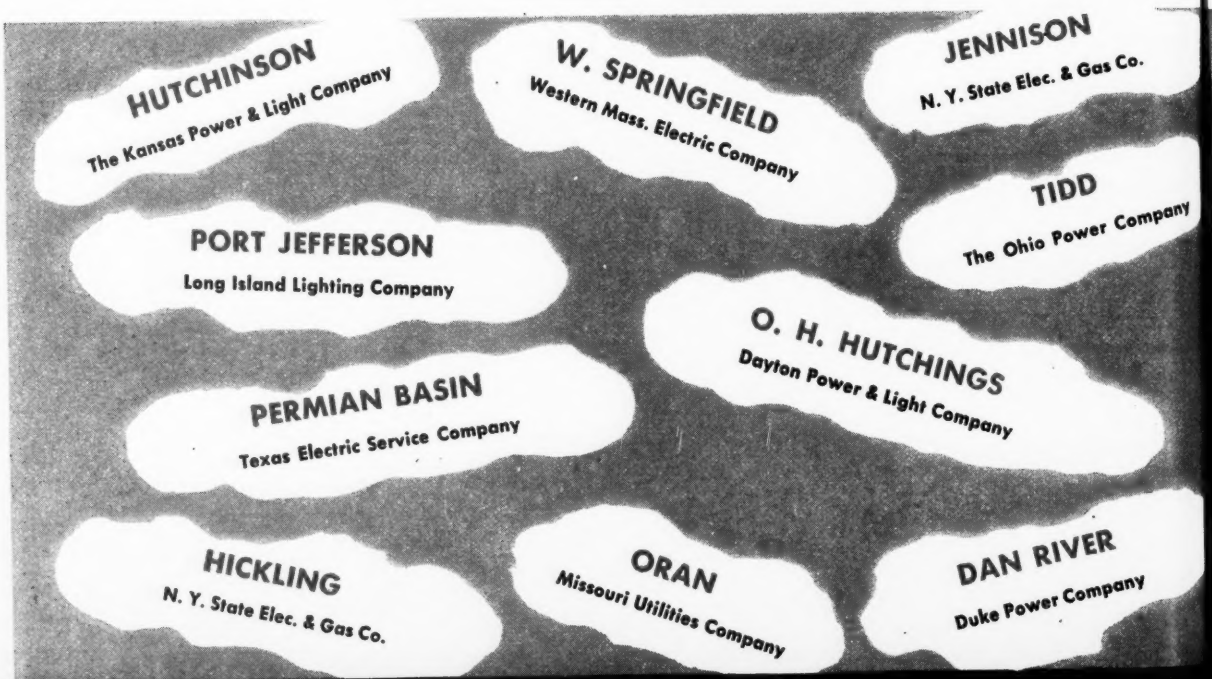
FOSTER WHEELER CORPORATION • 165 Broadway, New York 6, New York

FOSTER WHEELER



Cutaway view of classifier assembly. Preheated primary air enters the ball mill through a central air tube at each end of the mill. This air picks up its load of pulverized coal in the mill and travels through the annular space around the central air tube. In the classifier the coal-air stream is subjected to a cyclonic action that throws out oversized particles which are returned with the raw coal feed. The coal-air stream, containing only pulverized particles of required fineness, leaves the classifier through the center outlet shown at top.

3½ Million KW in



COMBUSTIONE

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS. ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

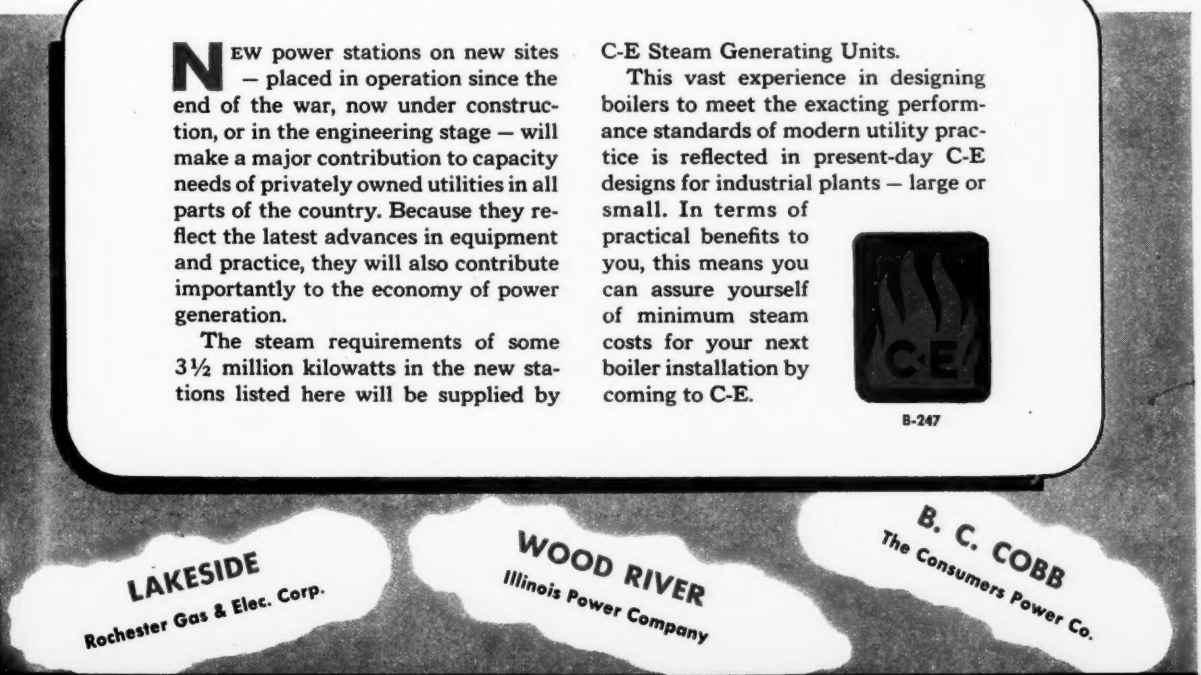
NEW Utility Stations

NEW power stations on new sites — placed in operation since the end of the war, now under construction, or in the engineering stage — will make a major contribution to capacity needs of privately owned utilities in all parts of the country. Because they reflect the latest advances in equipment and practice, they will also contribute importantly to the economy of power generation.

The steam requirements of some 3½ million kilowatts in the new stations listed here will be supplied by C-E Steam Generating Units.

This vast experience in designing boilers to meet the exacting performance standards of modern utility practice is reflected in present-day C-E designs for industrial plants — large or small. In terms of practical benefits to you, this means you can assure yourself of minimum steam costs for your next boiler installation by coming to C-E.

B-247



C-E ENGINEERING

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NEW EQUIPMENT NEWS

Use the coupon below when you want further information on the equipment described on this page and following pages. Write the identifying letter or letters in the space provided, clip the coupon and send it to Power Generation, 53 West Jackson Boulevard, Chicago 4, Illinois

A New Watthour Meter. A new watthour meter that features magnetic suspension of the rotating element has been announced. Designated as the Type I-50, the new floating disk meter has been designed to give almost a lifetime of trouble-free operation at minimum maintenance costs. A

small amount of magnetic material supports all the weight of the disc and shaft, thereby eliminating the need for the jewel bearings that have been a major cause for meter maintenance.

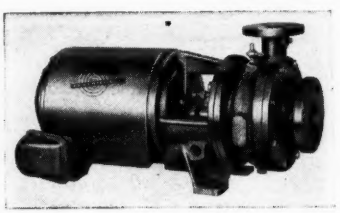
The magnetic suspension element consists of two concentric magnets of cunico, a high-coercive material, which have been placed one within the other. The outer magnet is attached to the meter frame, the inner magnet to the upper end of the disk shaft. The interaction of the two magnetic fields supports the rotating system at a small downward displacement. To keep the shaft in vertical alignment, stainless-steel guide pins are located at the top and bottom. Graphite guide bushings at both ends of the shaft run on these guide pins without lubrication.

Two small alnico magnets are die-cast into the frame, one on each side of the moving element. These minimize side thrust and the tendency to noise and vibration. The current coil, with brazed terminals, is molded directly to the core. Butyl rubber, noted for its long-life properties even at high ambient temperatures, provides turn, coil, and ground insulation. The result is a securely located current coil that is protected by the rubber from mechanical injury and abrasion. The potential coil, also molded for greater insulation strength, is encased in a polyethylene plastic of high dielectric strength and low moisture absorption. This new electromagnet design assures long life and calibration stability. Meters of smaller size and lighter weight result from unit construction, another feature of the I-50. Meter and Instrument Div., General Electric Co.

B Increased Capacity Circuit Breaker. The new frame-mounted oil circuit breaker, Type FZO-151, announced earlier this year in 69 kv ratings from 500,000 to 1,500,000 kva interrupting capacities, is now available in interrupting capacities to 2,500,000 kva, according to the company. Boston Works, Allis-Chalmers Mfg. Co.

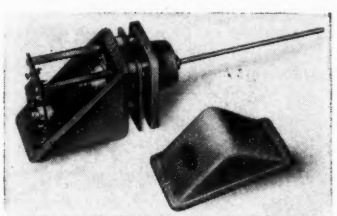
C Centrifugal Pumps. Centrifugal pumps with a wide range of capacities and heads have been added to a line of liquid control equipment for the handling of most liquids. Single and two-stage units ranging from ¼ to 75 hp and from 10 to 2500 gpm—including self-priming types— are suitable for a variety of applications and for viscosities up to 8000 S.S.U.

Four models are available: Close-coupled with common shaft—two feet under pump and two under motor; Close-coupled with pump mounted on extended motor shaft and pump adapter—four feet under motor; Pump mounted on base plate, with or without motor and flexible coupling; Self-priming pump mounted on base plate, with



or without motor and flexible coupling. Pump constructions are: All iron, bronze fitted or all bronze with steel shafts. Closed or open impellers. Bowser, Inc.

D Gas Burner Safeguard. System FF-6 provides electronic flame failure protection and semi-automatic ignition control for all types of commercial and industrial gas burning equipment as well as for oil fired equipment having continuous gas pilot ignition. It is recommended for use on boilers, ovens, furnaces, kilns and dryers. The flame rod is mounted near the



gas pilot on the burner plate and projects into the fire chamber. The rod is so located that its tip impinges on the pilot or main gas flame. The rod is wired to the control which may be located at any convenient point such as on the burner panel board. When flame fails, the flame rod signals this condition to the control which instantly cuts off fuel and can be wired to sound an alarm. Unlike thermal controls, Fireye responds to the flame itself, not to a secondary effect of the flame. System FF-6 incorporates many features. These include a completely fail-safe circuit with safety-start protection, a simplic-

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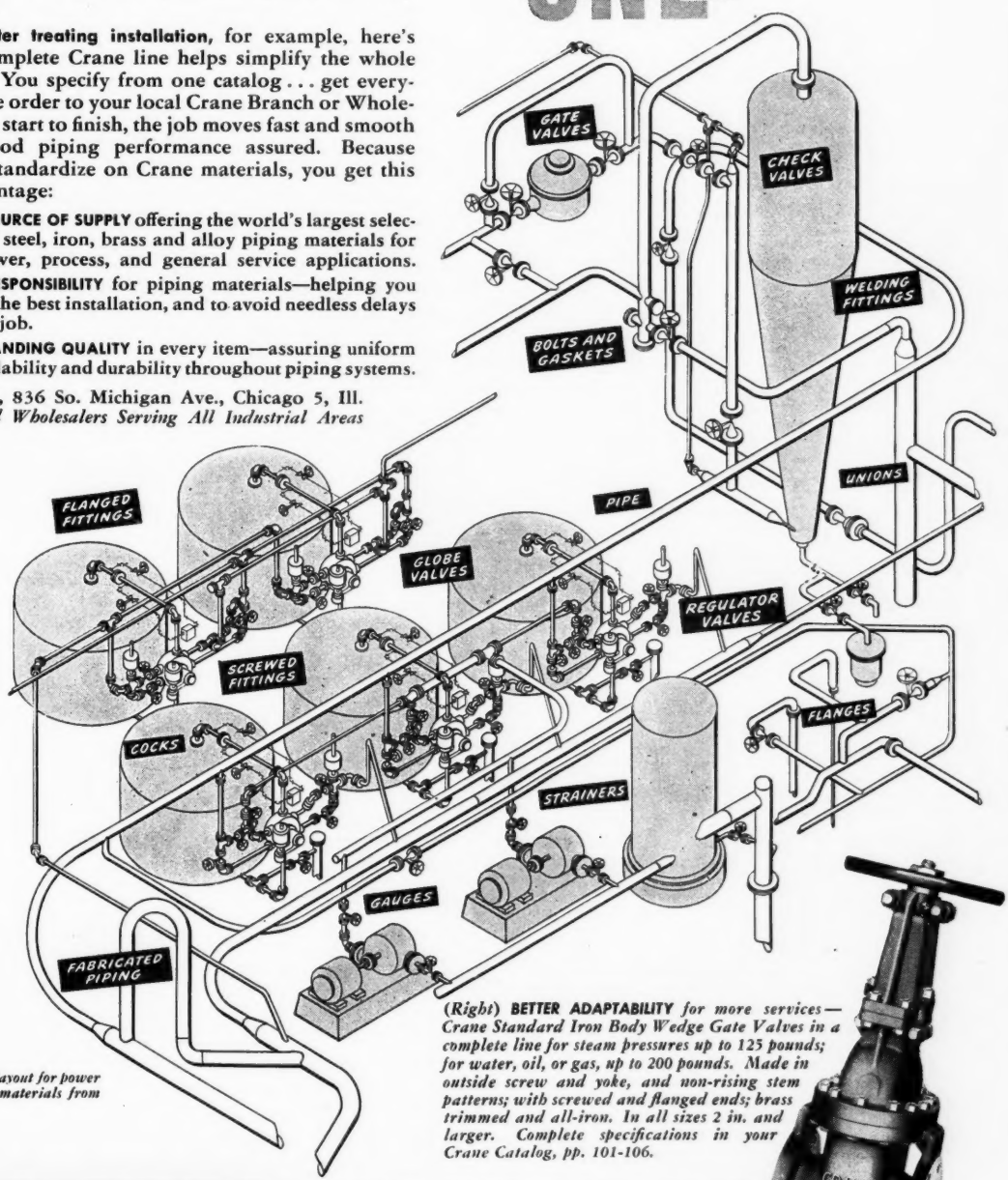

Water treating layout for power plant . . . piping materials from Crane.

(*Right*) **BETTER ADAPTABILITY** *for more services—Crane Standard Iron Body Wedge Gate Valves in a complete line for steam pressures up to 125 pounds; for water, oil, or gas, up to 200 pounds. Made in outside screw and yoke, and non-rising stem patterns; with screwed and flanged ends; brass trimmed and all-iron. In all sizes 2 in. and larger. Complete specifications in your Crane Catalog, pp. 101-106.*

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FOR EVERY PIPING SYSTEM

ity of installation on all gas burner heads, and immunity to moisture and eletrical leakage. Combustion Control Corp.

E Direct Operated Solenoid Valve. Introduced is model DS-2 direct operated solenoid valve. The new valve needs no pilot or either medium for

operation and the effective orifice area is equal to that of the pipe line. Designed to eliminate any packing requirements, and having corrosive resistant internal parts, assures for safe long useful production life. From laboratory and actual on the job research the DS-2 valve proved by actual analysis, that the removable resilient rubber type seat provides a leakproof seal.

The new valve is adaptable and can operate on direct or indirect current voltage and with various fluids such as oil, water, steam, air or freon. Airmatic Valve, Inc.

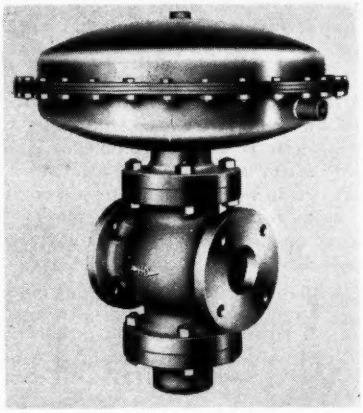
F AC Insulation Tester. The Model 2402 is a high potential ac insulation Tester designed especially for research, development, production or repair use where various voltages up to

2000 v are required in measuring the breakdown voltages and testing the insulation of insulating materials, compounds and liquids, and of appliances. A built-in variable autoformer provides smooth stepless control of the high voltage output without interruptions, thus eliminating damage by surges to equipment under test. The instrument is equipped with a direct reading voltmeter which is connected directly across the high voltage output and indicates the actual voltage applied. In addition, a milliammeter is provided which indicates the exact point of voltage breakdown by an abrupt rise in indicated current, which is a much more accurate method than that of relying upon the indication of a pilot lamp or the tripping of an overload relay to determine the point of breakdown. The milliammeter also indicates directly the amount of current flowing in the high voltage circuit at all times. The instrument is so designed that the load is automatically limited through its range to within the full scale of the milliammeter. The volt and milliammeters are provided with extra scale range to accommodate variations in maximum voltage and current due to possible wide variations in supply line voltages. Cole Instrument Co.

G Axial Flow Pump. A large capacity axial flow pump designed to resist contaminated sea water and other corrosive liquids is announced. The new pumps are especially suited to condenser circulation, and other services requiring low cost high speed pumping of large volumes of liquids.

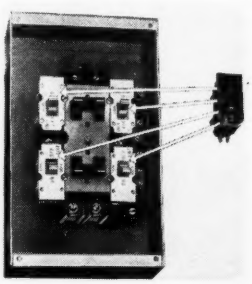
Nickel alloys play a major role in the construction of the new pump. Impellers and suction bells are cast of stainless steel. Pump shafts are 18-8 stainless. Column and discharge elbows are formed of a high test cast iron. These axial flow pumps are best fitted for applications where any variation in head is a reduction, and where the resultant increase in capacity is not objectionable. Economy Pumps, Inc.

H Diaphragm Control Valves. Announced is the 4000 Series Flo-Tested pressure loaded diaphragm control valves, which eliminate both packing boxes and springs. These valves provide supersensitive regulation wherever the controlled fluid may come in direct contact with the diaphragm. Fluid pressure from the outlet side of the body is applied to the under side of the larger area diaphragm instead of springs: Loading pressure from a remote operator or air operated instrument is applied to the upper side of the diaphragm in the usual way. This construction eliminates both springs and the packing box, thereby providing an almost frictionless valve, with no hysteresis. While either cast iron or steel bodies can be provided, the steel diaphragm cases are so large in area that the maximum working pressure of this valve is 250 psi. Common applications are back pressure and reducing service, as well as rate of flow control.



When firing boilers or stills on natural gas, these valves prevent inlet pressure variations from disturbing the controlled gas pressure. The normal ratio of input to output pressure is 1 to 1. Any range from 8 to 1 or 1 to 8 may be provided. Sizes are from ½ to 12 in. Hammel-Dahl Co.

I Ad-On Multi Breaker. A new type multi-breaker service and load center is announced. The new type MB 4 consists of a double polarity, four-pole basic unit with provisions to receive four more single pole Ad-on units. Thousands of circuit combinations can be made from only 33 standard basic units and three Ad-on units, all readily stocked.



Ad-on units are plugged in on main terminals. This method of adding circuits to the basic unit reduces installation cost of future circuits by eliminating the wiring, nipples, locknuts, and bushings required for installation of additional separate devices. The Multi-breaker can be used for direct switching of lighting and appliance circuits as well as to provide circuit protection. Single poles are calibrated 15, 20, and 30 amp. Double-pole 40 and 50 amp circuits have individual trip Square D Co.

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Meet All Requirements for Modern High Pressure, High Temperature Service

ANY engineer responsible for the design or operation of modern high pressure, high temperature steam plants can safely provide the benefits of completely automatic condensate drainage by specifying Armstrong Forged Steel Steam Traps. Their inherently trouble-free design plus highest quality materials and workmanship assure safety and dependable performance. There is no chance of failure to open when condensate fills the trap and no steam loss under no-load conditions. The extensive line includes traps to meet any pressure, temperature or capacity requirements.

Armstrong Forged Steel Traps are also ideally suited to low and medium pressure service where "all-steel" installations are desired.

Where quality, safety and dependability come first, specify ARMSTRONG, the "standard" in many high pressure plants throughout the world. For more complete information and prices, consult your nearby Armstrong Representative or write:

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CAP AND BODY FORGINGS:
Up to 600 psi—SAE 1030 steel
600 to 900 psi—ASTM F-1 moly. steel.
900 to 2400 psi—ASTM F-3 chrome moly. steel.

VALVE AND SEAT:
Chrome steel, heat treated.

BUCKET AND VALVE LEVER ASSEMBLY:
18-8 Stainless Steel.

BOLT AND NUT SET:
Bolts supertemp steel, 149,000 lbs. tensile:
Nuts, hex, semi-finish, S.A.E. 1030.

GASKET:
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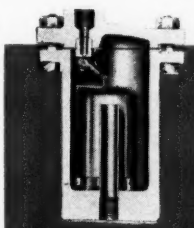
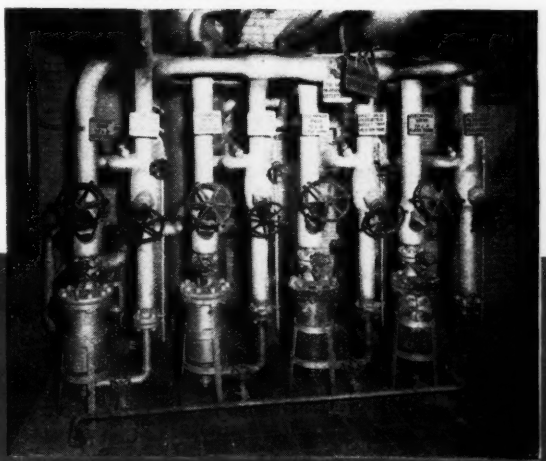
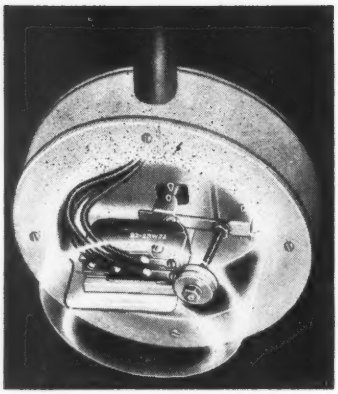


SEND FOR the 36-page ARMSTRONG STEAM TRAP BOOK for complete data on sizes, capacities, selection, installation and maintenance of Forged Steel and Cast Semi-Steel steam traps.



Wisconsin Electric Power Co., Port Washington Station

ARMSTRONG *Forged Steel* STEAM TRAPS

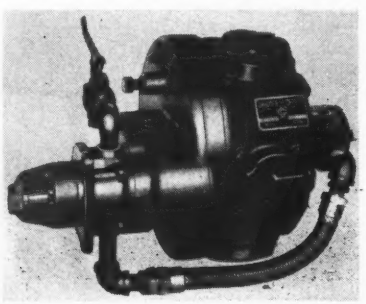


J **Bin Level Indicator.** The Bantam Bin-Dicator is designed for use on very small hoppers, spouts, chutes and conveyors, and other applications where it is not possible to use the standard Bin-Dicator because of its size. Unit is only 5¾ in. overall dia. Both standard and Bantam models are diaphragm-operated switches in sealed housings which mount on the outside of bins, hoppers, screw conveyors, etc., and signal changes in material levels. They will automatically start and stop filling and emptying equipment as the level of material reaches designated limits. They are used successfully on bulk materials weighing 2 to 350 lb per cu ft. A special arrangement of the Micro Switch is provided in units to operate on the light materials.

Unit is used to stop machinery when feed chutes or elevator boots become clogged with material. Special models are available for hazardous locations, and for internal mounting inside thick walled or multiple compartment bins. Bin-Dicator Co.

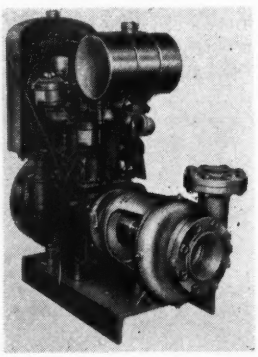
K **New Air Starters.** A new line of air starters for gas, gasoline or Diesel engines—including five sizes, developing from 3 to 15 hp on 100 psi has been announced. The principal advantages of these air starters, are said to be their high torque and the elimination of costly battery maintenance and replacements. The high torque characteristic of the piston type motor, it is said, makes it especially desirable for Diesel applications involving high starting loads, while the 5-cyl radial design provides even torque through the operating cycle.

An exclusive feature is an air actuated starter pinion which, when the air valve is open, automatically engages the ring gear a split second before the starter begins to crank the engine, thus assuring positive and safe engagement. Gardner-Denver Co.

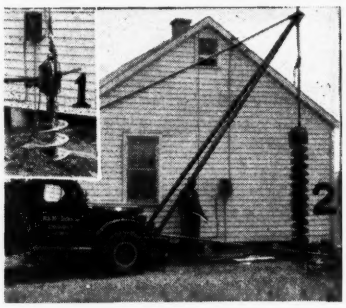


L **Gasoline Driven Welder.** A new portable 180 amp welder of the gasoline engine-driven type, is of exceptionally compact design, roughly 2 ft wide, 2 ft high, 4 ft long and weighing 500 lb. With a current range of from 20 to 180 amp the machine can be used for the welding of light or heavy gauge metal, and for the repair of cast iron structures. Lincoln Electric Co.

M **Diesel-Driven Pumps.** Announcement is made that several of the six and eight hp pumps are now available powered by single-cylinder Diesel engines equipped with electric starters. The Diesel can be connected to the pump either directly or by a belt, depending upon the depth of water or pressure required. The small consumption of low-cost Diesel fuel is said to make these Diesel-driven pumps especially economical to operate. In those parts of the country subject to power shortages, the Diesel pumps will help reduce the load on power lines. Jacuzzi Bros., Inc.



N **Earth Drill.** Temporary or permanent wells are drilled at the rate of 30 ft per hr 16 in. in dia with the drilling outfit illustrated, which can be mounted on any standard truck. This portable drill is designed to pull out the dirt, leaving a clean hole into which a caisson or pipe can be inserted immediately. Temporary wells can be drilled right at the location needed, the drill moved from place to place as construction progresses.



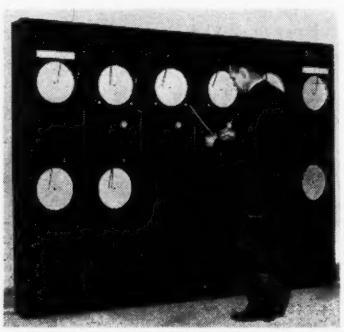
This is not a conventional type auger, but a drill with exclusive, patented features. Motor and drill are suspended from the boom, a switch is pressed and the drill starts operating. When the drill reaches the desired depth it is pulled out of the hole, carrying all the dirt with it.

Ka-Mo drills are used to make test holes, pilot holes for wooden, cast or poured concrete piling or posts; also for horizontal or angular holes for pipe, drains, and conduit. Drills are furnished in diameters up to 16 in., available in single lengths, or in several multiple units which can be attached as the work progresses, to reach the final desired depth. Ka-Mo Tools, Inc.

O **Panel Boards.** Announced are standard-size, sectional, steel panel boards which are fabricated to contain any type of control or indicating instrument. Constructed of 10-gage steel, these instrument panels provide support for precision-instrument operation.

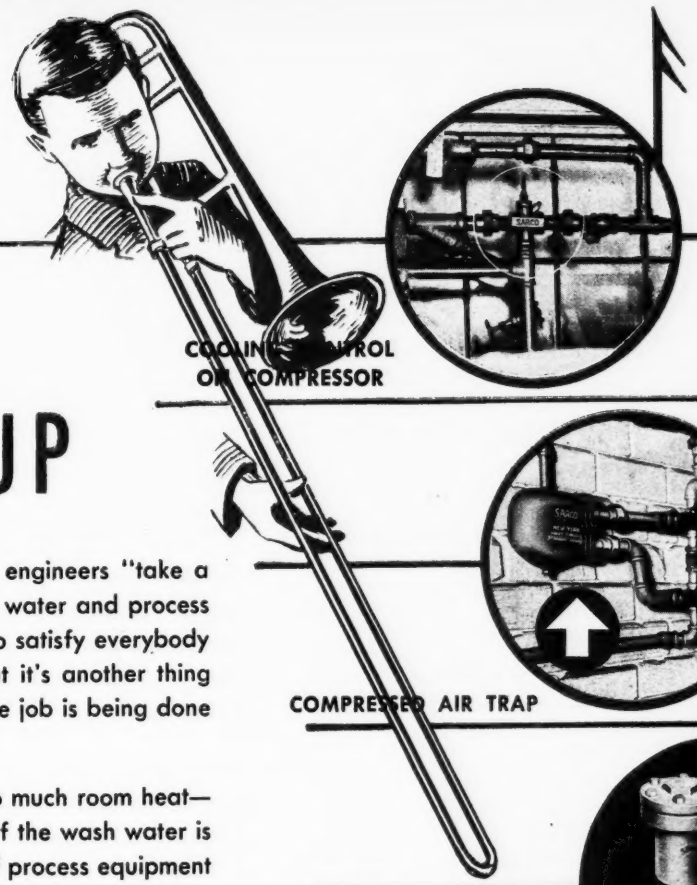
Versatility is offered by these new units because once standard sections have been erected, additional sections can be added, sections can be interchanged or removed, or otherwise modified to meet changing plant operating conditions. Standard panels have smooth, streamlined contours, and lend themselves for both efficient production operations and eye-appeal. There are no sharp corners, rough edges or protrudences, which insures safety.

Standard 18, 20 and 24 in. wide sections are supplied regularly in 6, 6½, 7, 7½ and 8-ft heights. Each panel has a 2 in. minimum return flange on top and bottom as well as on each side. Floor or wall braces are furnished to provide ample support. K & H Industrial Products.

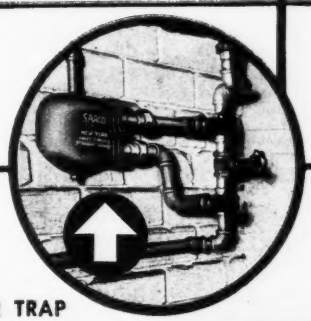


FOR THE ANNUAL

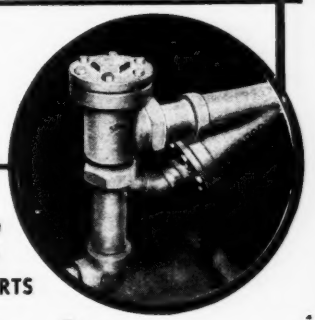
PLANT TUNE-UP



COOLING CONTROL ON COMPRESSOR



COMPRESSED AIR TRAP



SARCO No. 9 STEAM TRAP FOR QUICK STARTS

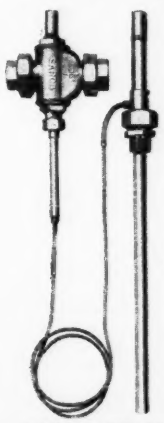
Once a year most plant engineers "take a look" at their steam, hot water and process hook-ups. It's one thing to satisfy everybody else on performance—but it's another thing to satisfy yourself that the job is being done efficiently.

Nobody complains of too much room heat—they open the windows. If the wash water is too cold, they let it run. If process equipment "takes time to warm up" and if critical temperatures wander up and down during the day, the plant losses may not be noticed, much less reported.

There is no excuse for any of these every day inefficiencies for there are Sarco Steam Traps and Temperature Controls that will prevent these losses and pay for themselves in a few months.

And there is a Sarco Representative near you who has done these things and a hundred more in neighboring plants, similar to yours. One phone call, or a letter and the Sarco Man will be glad to "take a look" at your plant with you.

SARCO AIR VENT



SARCO TR-21 HOT WATER CONTROL

SARCO WATER BLENDER

233

SARCO

SAVES STEAM

SARCO COMPANY, INC.

Represented in Principal Cities

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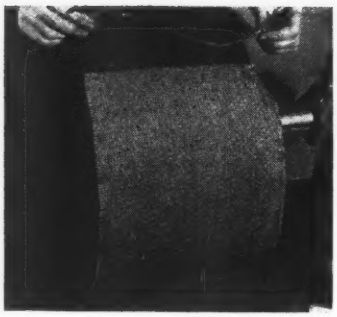
SARCO CANADA, LTD., TORONTO 5, ONTARIO



P **Waterproof Pulley Lagging.** Produced is an entirely new all-purpose waterproof lagging that is quickly and easily applied without rivets, bolts, or heat, and that dries within 10 hours at room temperature.

This tough, wear-resistant, all-purposes waterproof lagging adheres so firmly to all surfaces that a hammer and chisel are required to remove it. In addition, it is weather and corrosion resistant, unaffected by sulphuric acid, oxidizing agents, soaps, alcohol, petroleum products, etc. When dry it is odorless, tasteless, non-toxic and non-inflammable.

It is equally suitable for crown, split and flat pulleys, for use with leather, cord, wire-woven, or rubber belts.

It may be ordered in units consisting of 70 by 40 in. treated fabric and sufficient compound for application, cut to size for any pulley by specifying diameter and face measurements, or in rolls of any width up to 42 in. Condersite Engineering Corp.

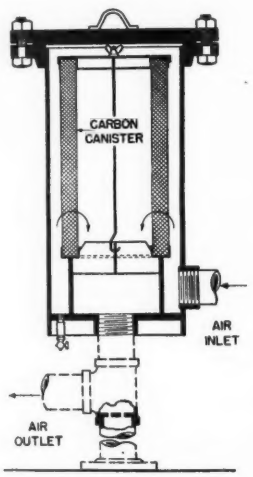
Q **Castable Refractories for 3000 F.** Announced is the development of two new castable refractories for service temperatures up to 3000 F. They are 3X Firecrete and 3X Blazecrete. 3X Firecrete is recommended for casting or pouring special refractory shapes of all descriptions, burner blocks, door linings, furnace covers, and complete linings. 3X Firecrete is handled as easily as ordinary concrete.

3X Blazecrete, while classified as a castable refractory was especially developed for pneumatic application in which it is shot in place by compressed air with guns. Gunning is used to advantage in new construction and also for repairs. Where gunning is not practicable, 3X Blazecrete can be readily trowelled in place. These new refractory products are said to help reduce outage hours in furnaces because they air harden quickly and can be ready for service within 24 hrs after installation. Both have negligible shrinkage from application to soaking temperatures of 3000 F and possess unusually high spall resistance. Johns-Mannville Corp.

R **Water-Soluble Cutting Oil.** A reputedly economical new cutting oil which at the same time eliminates the need of further rust prevention treatment for tools, materials and machinery is now being marketed under the name of Ferox.

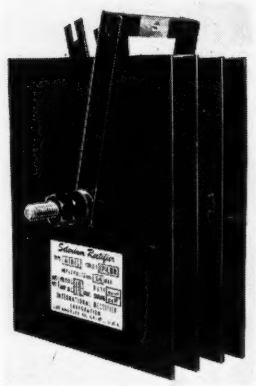
It goes further in any application where cutting oil is required. For most metals it is used one part Ferox cutting oil to 49 parts clear water. For use on cast iron and malleable iron, one part Ferox Cutting Oil is used with 33 parts of clear water. For operations which call for threading or polishing, one part Ferox to 35 parts clear water. The solution is said to remain completely clear at all times. No milky emulsion is formed because soaps and alkalies are not used. It is sold in 5 gal cans and 55 gal drums. Beacon Rust Proofing Co.

S **Compressed Air Purifier.** The compressed air line gas adsorber, one of a line of activated carbon air purification units, has recently undergone several modifications and improvements in construction. This unit, Type PL, is especially designed to extract all vapors, fermentation odors and other gaseous impurities from compressed air and is a device which effectively removes air-entrained contaminants not eliminated by commercial filters, separators, aftercoolers or receivers. Easy to install, and having no moving parts, the adsorber may be located at any point in the line. The removable adsorption canister is housed in a flanged steel shell containing internal manifold, air inlet, outlet and drain connection. The activated carbon adsorption medium has high retentivity, and frequently lasts several years before requiring replacement. When refilling becomes necessary it can be accomplished easily and quickly without breaking pipe connections. W. B. Connor Engineering Corp.



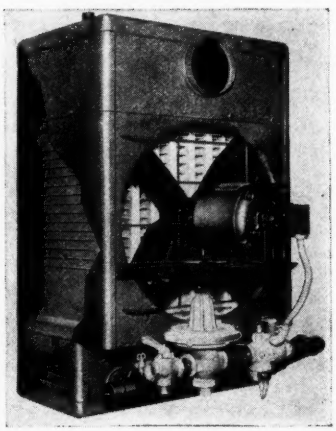
T **Selenium Rectifiers.** The individual selenium elements in these heavy duty selenium rectifiers, measure 6¼ by 7¼ in. and are rated at 12 amp, single phase bridge. The following features are incorporated in these assemblies: Interlocking assemblies of rectifier components, conservatively rated terminals, special moisture-proofing.

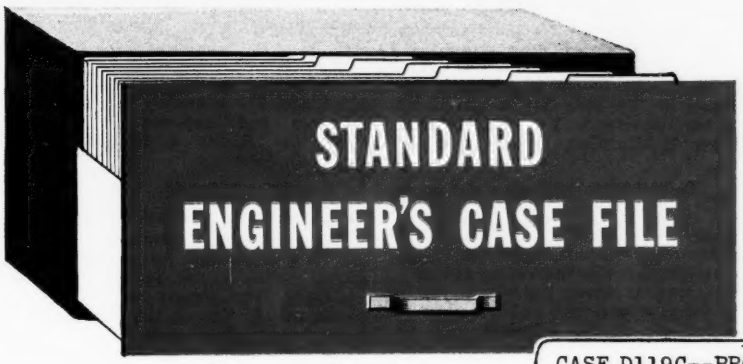
The elements have stable characteristics. Leakage current is less than 1 ma/cm² at 25 v rms in the reverse direction. These assemblies are especially suitable for all applications requiring output in excess of 10 amp. International Rectifier Corp.



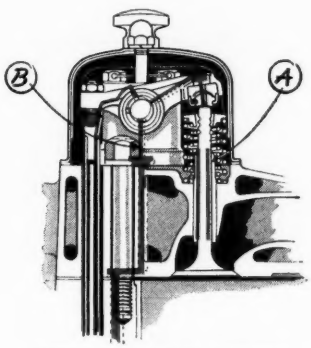
U **Gas Fired Unit Heaters.** New gas fired unit heaters that feature cast iron construction in both the heat exchanger and the combustion chamber have been placed on the market. Known as Series C in which cast iron is used for the heat exchanger and combustion chamber because it withstands the corrosive effects of the products from combustion of gasses. They are cast in one piece, and the extended heating surface fins on the heat exchanger are cast integral. They have been designed to consume exactly the right amount of air to support perfect combustion but without permitting an excess of air to lower heating efficiency. This is accomplished by means of a built in draft hood which absorbs all excessive chimney action and thereby conserves heat. The heater does not depend upon forced draft from the fan for either the primary or secondary air supply. For this reason there is no possibility of variation in the air supply to the burners resulting from changes in fan speed or louver adjustment. By the use of adjustable horizontal louvers, warm air can be directed to any desired level.

A tested and proved safety pilot is used on these heaters to automatically turn off the gas if the pilot light goes out or if it burns too low to insure perfect ignition. Automatic Gas Equipment Co.





CASE D119C--PROVIDING GOOD VALVE ACTION IN DIESEL ENGINES.



DIESEL ENGINE VALVE ASSEMBLY

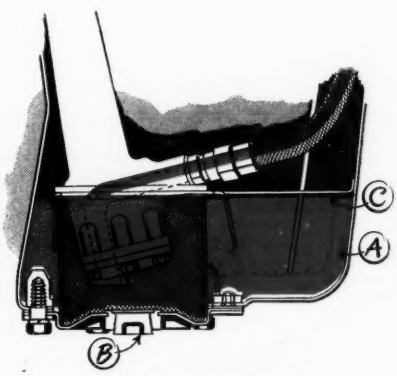
When Diesel engines, operating in tough heavy-duty service, were lubricated with compounded RPM DELO Diesel Engine Lubricating Oil, valve stems and guides did not gum up. They received thorough lubrication at all times and wear was negligible. RPM DELO Oil is recommended for all types of Diesels. Comes in several viscosity grades to meet all conditions.

A. Specially selected oxidation-resistant base stocks and special compounds prevent formation of gum and lacquer . . . oil film adheres to hot or cold metal surfaces.

B. Detergent compound keeps oil passages clean and open . . . and allows free flow of adequate supply of lubricant to wear points.

RPM DELO Diesel Engine Lubricating Oil is non-corrosive to all bearing metals. This quality and high stability assure sound bearings in Diesels for long service periods.

CASE D119D--KEEPING PARTS CLEAN AND REMOVING CONTAMINANTS FROM DIESEL ENGINES.



DIESEL ENGINE CRANKCASE

Cylinder walls, pistons, bearings and other parts of Diesel engines in heavy-duty service remained free of lacquer, and all contaminants flowed out with drainings when RPM DELO Diesel Engine Lubricating Oil was used.

A. A special compound in RPM DELO Oil loosens and removes lacquer and other deposits from parts and oil passages . . . and they stay harmlessly dispersed in the oil.

B. The finely dispersed contaminants, including condensate and dust, flow out freely when crankcases are drained.

C. Another compound in RPM DELO Oil prevents foaming —allows accurate measurement of oil levels and delivery of sufficient lubricant by oil pumps.

The engine-cleaning qualities of RPM DELO Oil help reduce wear on parts and prolong greatly the operating periods between engine overhauls.

For additional information and the name of your nearest Distributor, write

STANDARD OIL COMPANY OF CALIFORNIA

225 Bush Street, San Francisco 20, California

The California Oil Company
Barber, New Jersey

The California Company
17th and Stout Streets, Denver 1, Colo.

Standard Oil Company of Texas
El Paso, Texas

DIESEL ENGINE RPM DELO LUBRICATING OIL

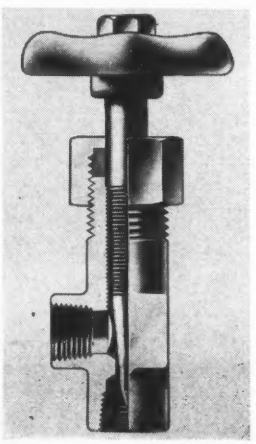
Trademarks Reg. U. S. Pat. Office

V **Air Velocity Meter.** Introduced is the Airite grille velocity meter, for indicating the velocity of air movement in an open space, as for example, air velocity at the face of supply or return air registers of warm air heating systems. Velocity of air movement is indicated, directly in feet per minute on a calibrated scale, by positioning the Airite squarely against the air flow. The instrument will measure air movement between 0 and 1200 fpm.

Its dimensions are 3⅜ by 3⅜ by 1⅝ in. It is equipped with a detachable handle which facilitates use on baseboard or low sidewall registers. A piece of ⅛ in. pipe may be screwed into the handle so that the instrument can be held against high side wall registers and ceiling outlets. Unusual features include an 8 in. long scale with 20 ft/min. divisions, and a lock by means of which the scale reading may be retained until the lock is released. List price, complete with handle and leatherette case - $22.00. Bacharach Industrial Instrument Co.

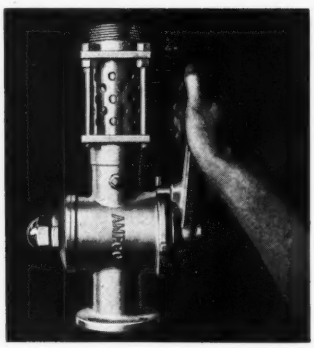
W **Needle Valve.** The Bulldog needle valve is built with a stainless steel stem, having the longest practical taper possible in a valve of its length. In combination with this extremely slim needle, to effect the ultimate in delicate flow-control, a real micrometer thread is machined on the stem.

This fine thread allows the valve to be opened or closed in tenths of a thousandth, thus effecting the absolute accuracy of control for which this valve is built. The bodies are machined from solid bars, eliminating possibilities of porosity leaks found in castings. The threads in the body are a class 3 fit and are inspected to Aircraft Standards. Carpenter Mfg. Corp.



X **Liquid Wire Stripper.** Stripping of electrical wires is speeded by the use of Formula 21, new developed for removing Formex, Formavar, enamel and similar wire insulating coatings. Use is simple: merely dip wire in liquid and wipe off with rag or blow off with compressed air. No scraping, tools or special cleaning is required. This new product is non-corrosive, non-inflammable, and will not harm fabrics, wood, or metal. Available in 2 oz bottles, one and five gallon cans, Formula 21 is applicable for use in mass production as well as for repairs to motors, coils, relays, and similar electrically wired equipment. Aircraft-Marine Products, Inc.

Y **Bronze Plug Valve.** A new corrosion resistant all bronze plug valve is now being produced. The use of this valve is said to prevent contamination of liquids. It is strong and durable. Will not leak as standard non-lubricated design. Lubrication feature can be supplied if desired.



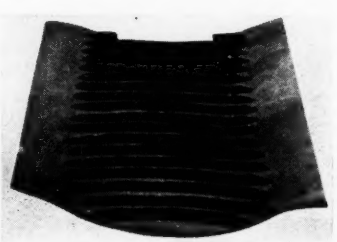
Design features include corrosion resistant materials throughout, no resistance to flow when open, no turbulence, self cleaning and easy to operate. It may be furnished with any type connection—flanged, threaded male or female, or hose coupling thread. Provision is made for pipe connections for flow meter, gage, by-pass clean-out, gas injector on the 2 in. size. The 3 in. size can be furnished three-way or two-way as desired. Made in sizes ½ to 4 in. Optional is a metal protected sight glass of pyrex which permits continuous easy inspection of the flow of liquid. It can be easily removed when not needed. Ampco Metal, Inc

Z **Air Driven Generator.** The AL-150 Airlite will supply ample power to operate two 75 w, 115 v, bulbs. Light for working in dark locations on construction, repair and public utility jobs, is now available without stringing temporary electric lines to the job. The Airlite cannot be harmed by short circuits or overloads, if the output terminals are directly shorted, light is restored the instant the short is removed. Compressed air not only powers the tools that do the work, it now also lights the job. The unit is a perfect companion for every portable compressor. It weighs 8¾ lb and measures only 7¼ by 5 by 5 in. without handle. Both 115 v and 220 v models are available. Compact and enclosed construction make the Airlite a foolproof unit. Ingersoll-Rand Co.

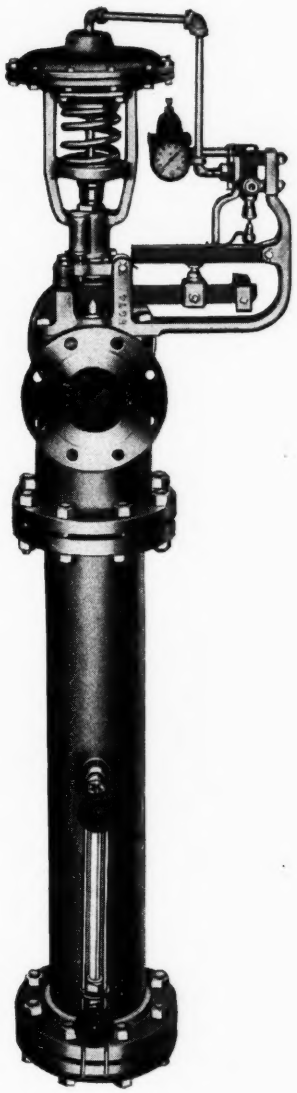
AA **Fluid Transmissions.** These new variable speed transmissions consist of a volumetric, variable delivery, radial rolling piston pump driving a constant displacement radial rolling piston motor. Oil, as the fluid power, flows from unit to unit through adequately proportioned passages, it provides automatic forced and flood lubrication, and insures long life. A compact case encloses the operating mechanism while integral relief valves in fluid passages protect installation against overload. Oil reservoir can be integral with machine or separate. To accommodate the cycle and functional requirements of a wide variety of applications, these transmissions with several tried and proven control devices are offered:

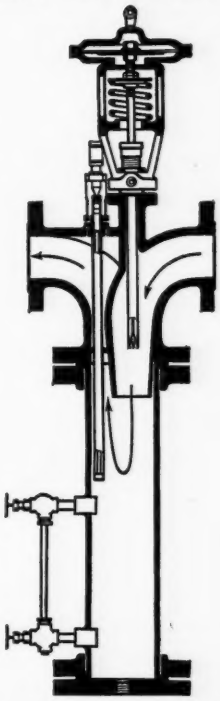
Hand screw control for accurate setting of output shaft speed, from zero to maximum, in either direction with 3.4 turns of a small graduated knob on side of transmission. Hydraulic servomotor lever control for stepless variation of output shaft speed in either direction and for quick reversal of rotation by finger tip actuation of a small lever. Hydraulic two-speed control for remote selection of adjustable pre-set speeds in either direction or fast and slow speeds in one direction. Electric three-position remote control for independently adjustable pre-set speeds in either direction and neutral or idle position selected manually or automatically from convenient remote push-buttons or switches. Oilgear Co.

BB **Ribbed Conveyor.** A new ribbed-top conveyor belt designed especially to prevent backslip in carrying sand and gravel, wet-mixed concrete, gold dredgings and other soupy materials up steep inclines, has been developed. The new belt features chevron-shaped ribs ¼ in. higher than the belt surface. The ribs serve as barriers, trapping the water and preventing the backwash of materials down the belt on inclines up to a 20 deg angle. The ribbed cleats also increase belt-life by reducing the severe wear a back-slipping load inflicts. The curved ribs are closely spaced to overlap each other and assure a smooth return run of the belt over idlers. The new belt has a five-ply rubberized fabric body, and a ¼ in. top cover in addition to the ribs. It is being made in widths of 30 to 48 in., and in lengths to specifications. Goodyear Tire & Rubber Co.



Self-Contained DESUPERHEATER





Cooling water completely atomized at all rates of flow . . . final steam temperature held closely . . .

Easily installed, the COPES Desuperheater holds the final steam temperature within plus-or-minus 5 degrees F., regardless of changes in initial temperature or rate of flow. Self-contained, it has no outside valve controlling flow. Complete atomization of the cooling water is assured by controlling its flow at the spray nozzle, across which pressure drop is held constant. Intimate contact of water and steam is at point of greatest turbulence in mixing chamber. Write for descriptive Bulletin 405-A.

NORTHERN EQUIPMENT COMPANY
982 GROVE DRIVE, ERIE, PA.
BRANCH PLANTS: Canada, England, France and Austria
Representatives Everywhere

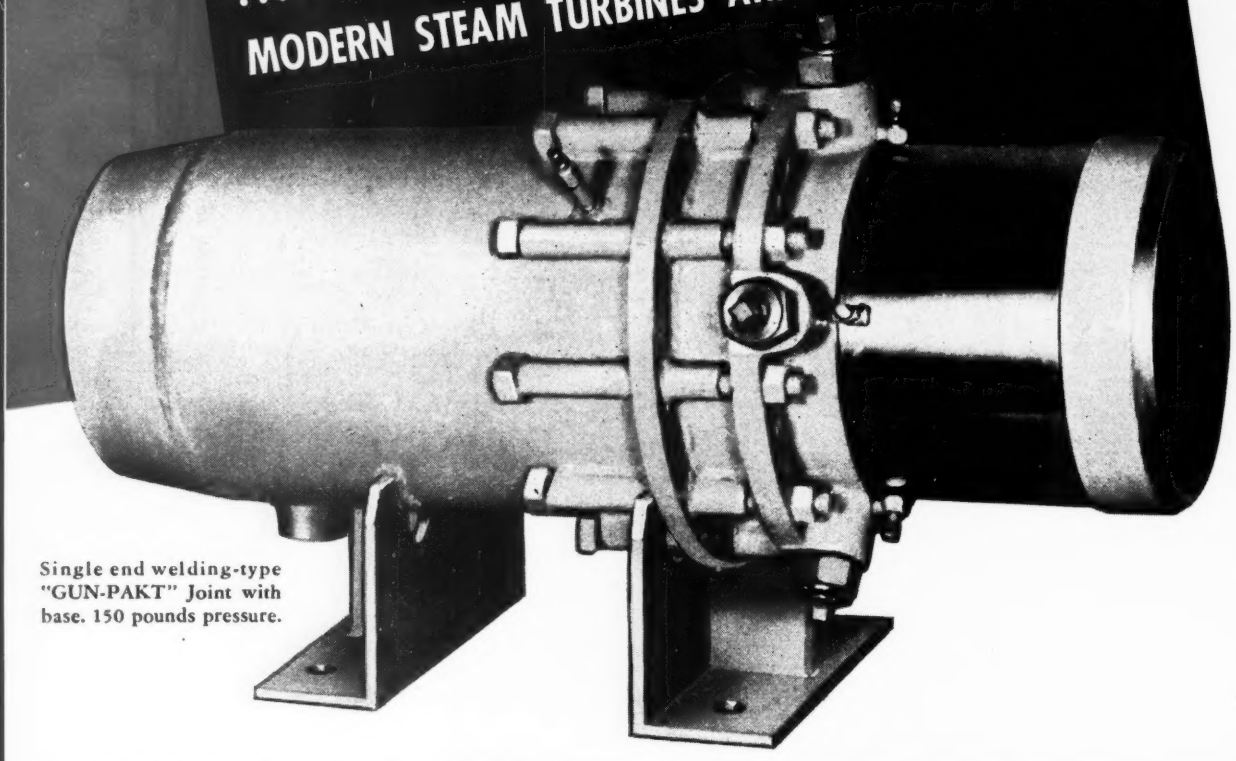
ENGINEERED BY THE MAKERS OF COPES
FLOWMATIC

COPES furnishes pressure-reducing and desuperheating stations designed and built for the individual installation. COPES also builds-to-measure boiler superheat controls responsive to both steam flow and temperature.

COPES
Headquarters for . . .
Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

GUN-PAKT EXPANSION JOINTS

...AS IMPORTANT TO STEAM DISTRIBUTION AS MODERN STEAM TURBINES ARE TO POWER PLANTS



Single end welding-type "GUN-PAKT" Joint with base. 150 pounds pressure.

The "GUN-PAKT" feature has been called the greatest expansion joint improvement of modern times.

It completely eliminates the need for costly shutdowns and heating interruptions while servicing the joints. "GUN-PAKT" Expansion Joints are repacked *under full steam pressure.* Insert a packing plug, twist a wrench, and the job is done. It's as simple as that. Special Alemite fittings provide for proper lubrication.

Maintenance costs are reduced too. One user spends 65 cents per year per joint. Another sets the figure at half that! Wherever steam is distributed, the "GUN-PAKT" Expansion Joint is the one they talk about—and specify!

FOR THE FULL "GUN-PAKT" STORY, GET YARWAY'S FREE BULLETIN EJ-1911. WRITE...

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.

Serviced

UNDER FULL STEAM PRESSURE

1. INSERT YARWAY PACKING **2. TWIST A WRENCH.**

THE JOINT'S TIGHT . . . THE JOB DONE

YARWAY GUN-PAKT EXPANSION JOINT

WHAT LEADERS SAY

Engineers!—Come Out of the Kitchen!

By DR. OTTO EISENSCHIML

IT SEEMS to me that the time has come for the members of the Chicago Technical Societies Council to decide whether they wish to keep its activities within its present limited scope, or widen it to include the social advancement of the professions comprising its membership, so that we may make our influence felt in public life.

I ask you, is it not time for us to come out of the kitchen and sit in at the family table, where bigger matters are being discussed than the cooking of meals and recipes for new kinds of noodle soups or apple dumplings?

No one is going to invite us to share the privileges of the dining room or parlor. Privilege is what you take, and so far the privilege of guiding public opinion has been taken mostly by lawyers, bankers, ministers, brokers, columnists and salesmen. They, not we, exert an influence on the thinking of their communities. Why they should think themselves especially fitted to hand out advice on anything from peanut growing to the weapons of the next war, I do not know. All of us have undoubtedly laughed at some of their outpourings, but have we done anything about getting into the line-up? If so, what? These self-appointed leaders have firmly imbedded themselves as such in the popular mind. The technical professions do not count for much outside their respective kitchens.

You have seen streets named for war heroes, poets, and real-estate speculators; have you ever seen one named for a dead chemist? I haven't. Why not? That in reality technical achievements are worked out by men of flesh and blood, with human ambitions and the desire for appreciation, does not ever seem to occur to an outsider.

Deep-Seated Ignorance

Ask one of your intellectual friends if he has heard of vitamins. He will look at you with scorn. Of course he has heard of them, in fact his whole family is using them. Then ask him if he knows who discovered vitamins, and watch his blank stare.

Try the same question on aspirin, synthetic rubber, jet propulsion, film photography, sulfa drugs, ethyl gasoline. Ask him who built the first skyscraper, the first suspension bridge. Who cares? The cook in the kitchen bakes the pie, and if it is tasty, the lady of the house smilingly acknowledges the compliments of her guests. No one cares for the cook or wishes to be introduced to her.

During the last war we glamorized a great many names, names of generals, soldiers, statesmen, politicians, foreign correspondents. I have no desire to detract from their glory, and I would not rob them of a particle; but how about the men who made planes fly ten miles an hour faster and then still faster, made our tanks better and better, our explosives superior? How about the men who developed the jelly incendiary bomb, the fungicides for the Pacific, and the thousand and one other items which made life for our armed forces safer and healthier, and victory more rapid and secure? Did you see their names in the paper? Did they get Purple Hearts and distinguished service crosses?

The Shame of It

What can we do to remedy this situation? Whatever we decide to do, if anything, results cannot be hoped for over night. We must proceed according to a program, which should be carefully laid out and consistently followed through. We must remove from the man in the street the picture he has of an obscure engineer in shirtsleeves bending over his drawing table, a pencil in one hand and a slide rule in the other; of a subdued chemist, dressed in a smock, pouring mysterious liquids from one test tube into another, while gazing at them with a scrutinizing eye. Instead, we must impress people that we are the creative professions, the men to whom the nation owes much to its health, wealth and comfort, and nearly all its material progress.

Never again should we stand idly by, as we did, when Dr. Fleming, the discoverer of pennicilin, during a recent visit to Chicago, received only a few lines on a back page; when the death of a chemist like Thomas Midgely, the inventor of the Delco system and of ethyl gas, was glossed over in the obituary column, while on the same day the sickness of Ethel Barrymore was lamented in an editorial as a near-calamity. A few dry words for Ethyl gas, a tear-stained editorial for Ethel Barrymore.

Experiences In The Last War

That people do not understand the importance of technical and scientific men was clearly demonstrated during the last war, when Selective Service failed utterly to comprehend what creative brains meant in a struggle for national existence, by putting thousands of chemists, engineers and scientists into uniforms to perform menial duties. Even after V-J Day those who had heretofore been exempted, the cream of the lot, were mercilessly drafted. Schoolrooms were emptied of engineering students, thus causing shortages which now haunt us.

The reason for this suicidal attitude on the part of our lawmakers

(Continued on page 140)

Here are excerpts from a recent address by Dr. Eisenschiml before the Chicago Technical Societies Council, reprinted in Sci-En-Tech-News. It emphasizes again a point that has often been made by engineers in the past and frequently by us in these pages that society is almost completely ignorant of what one of its most important groups is doing—and that something ought to be done about it.

Many people know Dr. Eisenschiml as an authority on the life of Lincoln, but few outside engineering circles know that he is one of our leading chemists and industrialists. He has made himself an authority on Lincoln and has written such books as "Why Was Lincoln Murdered," "In the Shadow of Lincoln's Death" and others. His latest books, however, are not on Lincoln but on the "Art of Worldly Wisdom" and "The American Iliad."

These, however, are his avocations. His work is that of the chemist, engineer and industrialist. Born an American citizen in Vienna, Austria, he served as chemist for Carnegie Steel Company, Pittsburgh, Pennsylvania from 1901 to 1904. Then until 1912 he was chief chemist of American Linseed Company, Chiago. From 1912 to the present he has been owner and president of the Scientific Oil Compounding Company. He is co-author of the Eisenschiml-Copthorne method of determining fish oils in vegetable oils and inventor of other technical processes. He has been chairman of the Chicago Section of American Chemical Society, president of the Chicago Chemists Club, active in various national, state, and local scientific committees and organizations.

Along with this he has carried on a distinguished career as a participant in community activities, defense committee activities during the war, author of the books mentioned above and of many magazine articles on London and on general subjects. Thus he has had unusual opportunities to observe how the public regards scientists and engineers and to form opinions on what technologists should do about it.

Utilities' Materials Handling Problems

Part I. Electric Utility Companies have a materials handling problem that is quite different from the materials handling problem of most industries. One reason for this difference is the far flung character of the utility—the great areas they serve. In this article, which is based upon an address delivered by the author at the National Materials Handling Exposition in New York recently, are set forth the methods used and the facilities provided for materials handling by the Detroit Edison Co. The subject is too broad to cover in a single article. In this part, Mr. Clark considers the first two divisions of the Utilities materials handling problem—that involving power plant materials and equipment, and Overhead Lines Material. A second article to be presented in a subsequent issue will cover Underground equipment, Sub-station equipment, General hauling of material, etc.

By R. A. CLARK, Assistant General Storekeeper, The Detroit Edison Company

ONE MAY well ask "Does a public utility have a really big materials handling problem, and just how does it differ from that of other industries?"

Few of the many of the people who flip a light switch in their home, plug in a toaster for their breakfast toast, or use a vacuum cleaner, radio or the many other convenient electrical appliances in the course of their daily living, seldom give any thought to how that electrical energy arrived there, so conveniently for them to use.

Yet, linking that convenient electrical outlet or light switch to the powerhouse from which the electrical energy comes, are many miles of copper wires and cable, with numerous pieces of electrical equipment, transformers, switches and the like in substations. To install and maintain this equipment, alone provides quite a material handling job.

Probably one thing that comes to mind to some people is the fact that a lot of coal is used in a steam power plant to make electricity. It is true, for a power plant may use upwards of 2500 tons of coal a day—a full train load of from 50 to 60 cars.

The handling of all this coal, of course, presents no small job. The unloading of the cars, preparation for burning by crushing or pulverizing it, and delivering it to the boilers is sometimes—especially in winter time when the coal is frozen—the most difficult part of the operation of a power plant. Mechanical handling equipment—car dumpers, bucket cranes, drag line scrapers, bulldozers, conveyors of several types:—belt, bucket, skip hoist, all have variously been employed to efficiently handle the coal into and out of storage piles and into the plants where it is burned. The handling of coal and the disposal of ash from the boilers makes quite a story in itself.

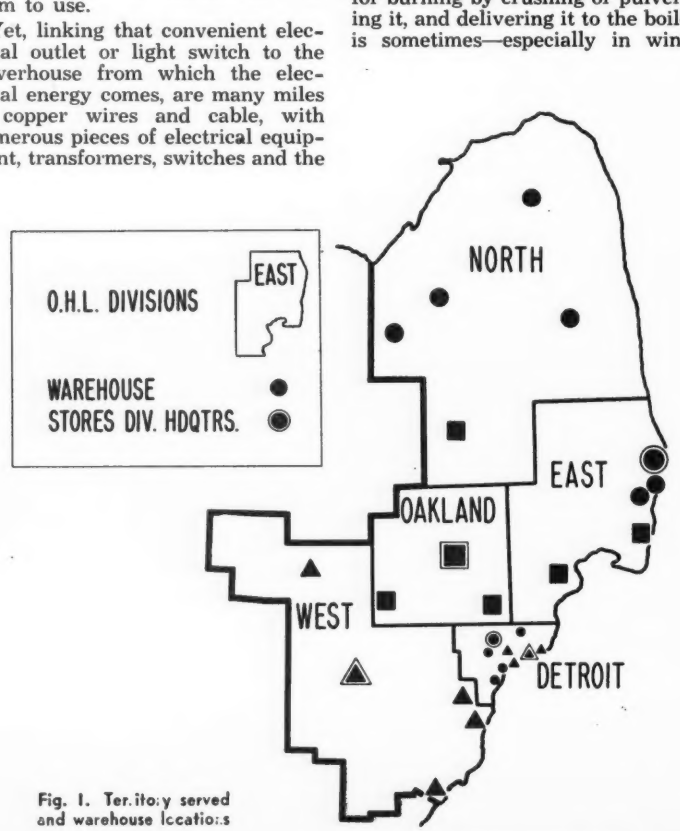


Fig. 1. Territory served and warehouse locations

However, there are a lot more difficult problems to be solved in the efficient handling of the materials and equipment utilized by power companies in getting the electrical energy from the power house generators to the point where it is so convenient to its customers.

The company which I represent is essentially an electrical utility. It serves a total area of about 7600 sq miles, which includes the metropolitan area of Detroit, an industrial area of about two million population, also five smaller cities of an industrial character. The territory is otherwise largely agricultural, with numerous towns and villages scattered throughout. At present there are over 850,000 customers. Over 36,000 farms are served with electricity, better than 97 per cent of all the farms in the territory. The company also serves an area in Detroit of about 3 sq miles with steam for heating purposes, and operates a gas producing plant in one of the smaller cities which it serves with gas for heating and cooking.

To serve its customers with electric energy, it operates four large steam power plants located along the Detroit and St. Clair Rivers as much as 60 miles apart. A total of 34,000 miles of overhead transmission and distribution lines form a network over the 7600 mile area, and

Fig. 2. Power Plant spare parts storage

Fig. 3. Boiler casting storage

3000 miles of underground cables are combined to transmit the electric energy from the power houses to the customers. Two hundred and thirty electrical substations where high voltage transformers and switching equipment are located over the whole area.

Forty-five miles of underground pipe line are utilized in the distribution of steam heat from four boiler plants strategically located to supply steam for that purpose. An additional 290 miles of underground pipe line are used to distribute gas to users from the one gas plant.

That the system is continuously growing, is indicated by the fact that the electrical load on the power houses is today about double what it was in 1935, and about 20 per cent higher even than during the war years. Rebuilding of the system to handle increasing loads was greatly deferred during the war years, so that new construction of plants, substations and lines and the rebuilding of lines to handle increased loads is presently at an all-time high.

All this equipment must be maintained and operated 24 hours daily and 7 days per week. The company itself does most of the construction and maintenance of its plants, substations, and lines and it procures all the materials and equipment needed for these operations. It is the problems connected with the handling of these materials and equipment that I will consider in this article.

The Army has a word for it—"Logistics" which we heard much about during the war. It is the problem of procurement and distribution of materials and equipment at the proper time to the proper place where they are needed.

Most utilities place the responsibility for the handling of materials and supplies in the hands of a Store's Department. In The Detroit Edison Co. this Department operates 26 warehouses which are located throughout the territory served. In these warehouses and stockrooms are carried over 23,000 different items used in all the various phases of the company's construction, maintenance, and operation. These materials may be roughly divided into the following types: Power Plant materials and equipment, Overhead Lines construction materials, Underground cable lines and pipe lines materials, substation equipment, and miscellaneous materials such as office supplies, building maintenance and janitor supplies, etc.

I. Power Plant Materials and Equipment

A stockroom is maintained at each power plant for the purpose of handling and storing the various supplies used in the operation and maintenance of the plant. Around 3000 stock items are required at each plant for normal operation, which number will include about 2000 spare parts for equipment maintenance—such things as turbine repair parts, pump parts, motor parts, boiler repair parts (mainly iron castings, fire brick, boiler tubes and the like). Then there are usually 50 to 75 different sizes and types of pipe, about 400 different sizes and types of valves and pipe fittings and about 500 more items such as bolts and nuts, small tools, steel shapes, paint and janitor supplies. During times when heavy construction work may be in progress at a plant, additional supplies are usually required.

The plant storeroom may consist either of space set aside for that purpose in the plant building proper or in a building separated from the plant itself. Since materials and parts are drawn from the stockroom only at the time they are used, it is desirable to have the storeroom located as closely to the plant as possible in order to prevent excessive time being lost by the workmen going to and from the stockroom.

The "spare part" items may vary in size from small parts which can be stored in drawers or bin shelves

Fig. 4. Power Plant warehouse

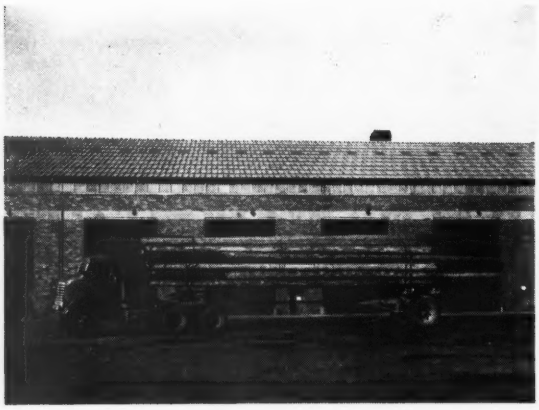


Fig. 5. Pole truck

Fig. 6. Overhead Line warehouse interior

to such large items as two-ton rotors for large motors or pumps. Only small quantities, one or two each, are carried of most of these items, since they are kept for the most part as "insurance" items against emergency shut-down of equipment to make necessary repairs. Very often these parts lie in storage for years, sometimes for the entire life of the equipment, without being used. It is therefore essential that they be protected in storage against rust or other damage that might occur in handling during long periods of storage. Since they may be required for use at any time of the day or night, they must be stored so that they may be readily located and easily moved from storage to the point where they are to be used in the plant.

Storing the heavy parts in areas accessible to an overhead crane or hoist so that they may be placed on four-wheel platform trucks for transportation where needed has been, for the most part, the answer

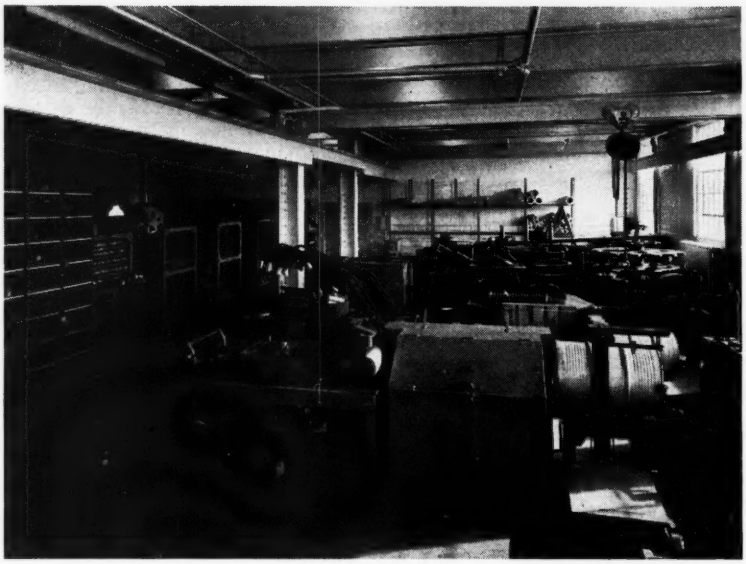


Fig. 7. (Above) Typical plant stockroom

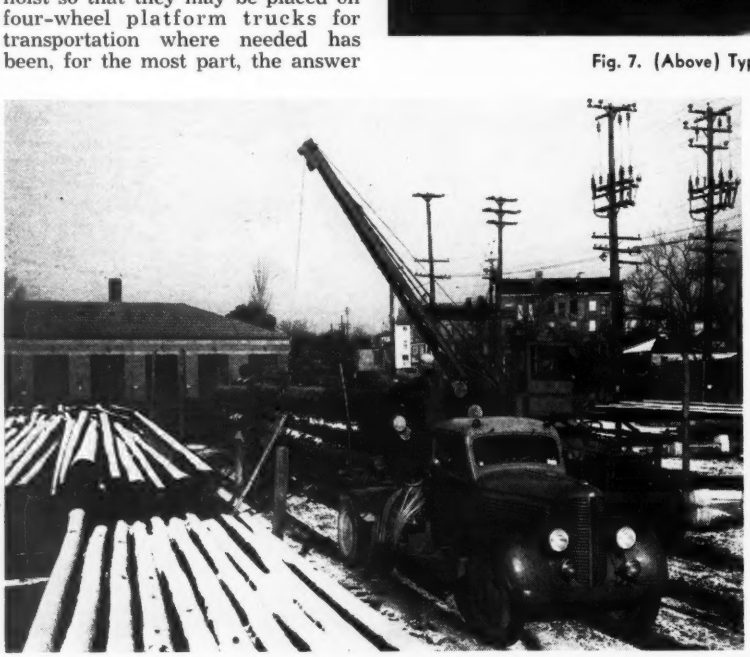


Fig. 8. Yard crane

of how to handle these items. Four-castered dollies also have been used to advantage to store these parts when a traveling hoist is unavailable to the storage area.

Boiler repair castings—stoker castings, etc.,—of which there may be as many as 500 different items ranging in quantity from one or two of each item to several hundred, sometimes taxes the ingenuity of the storekeeper to the limit to devise ways to pile the castings so that they may be readily located and inventoried. Steel racks with 3 to 4 shelves are used to advantage to store small castings and those where quantity on hand is small. Castings may range from those of very light weight to pieces as much as 200 to 300 lb, thus requiring a hoist to handle them.

The handling of fire brick offers much the same problems as castings, except that they are easily damaged by handling, and cannot withstand being piled too high.

Fig. 9. Pole yard

Four-wheel platform trucks, two-wheel hand trucks, two and four-wheel dollies in combination with overhead hoists have been used most generally in handling the materials used at power plants. These trucks should be of heavy construction (good for upwards of two tons load) with wheels which can be rolled safely over tiled operating floors in the plant. A few types of materials may be palletized (such as fire brick and castings) to advantage and others mounted on skids could also be handled by a fork lift truck. Some work is being done at the present time to adapt lift trucks to the handling of plant type of materials. There seem to be limitations which make it difficult to justify the investment in a lift truck for handling this type of materials.

II. Overhead Lines Materials

In the construction and maintenance of the overhead transmission and distribution lines there are about 1500 different items required. These consist of such main groups as wood poles and crossarms, steel towers for those long cross country high voltage transmission lines, wire, insulators, transformers, lightning arresters, fuses, switches, street lighting units and parts, and numerous hardware items for the installation of these types of equipment.

Because the pole lines are so far-flung, covering the whole of the 7600 square mile territory, it is obvious that the line crews must have headquarters in numerous locations in order that they be within reasonable driving range of the territory they service. In the earlier days, before the advent of good roads, the line crews worked out of almost every small village and town, as well as the larger urban centers. Even today, the crews work out of 16 scattered locations. Sixteen warehouses, therefore, operated in these locations, serve as combination headquarters and garages for the line crews and their trucks as well as warehouses for the materials they use.

The whole territory is divided into four divisions with headquarters for supervisory and other purposes located at the largest warehouse in the division. The warehouses may range in size from some serving three to four line crews to those serving 25 to 30 crews. The warehouse operating force may consist of from 3 to 25 men, as the need may be.

Direct delivery of materials from vendors to all warehouses is effected where possible. Each warehouse may carry from 500 to 1200 items, with sufficient quantities of each to take care of the construction and maintenance requirements of the crews served. Wood poles are carried at four main poleyards located at each of the four division headquarters warehouses. Small supplies of poles are carried at remotely located warehouses for emergency maintenance purposes. The poles are delivered to the yards in carload lots, usually loaded on flat cars. They are unloaded by means of portable boom cranes, and placed on skidways, graded by size and type. The poles range from 25 ft long to 70 ft and weigh from 500 lb each to 4500 lb. The use of a boom crane with grab hooks or choker sling, moving one pole at a time has been found to be the safest way of handling poles, particularly in unloading them from flat-car loads. This method is recognized to be rather slow, however.

Poles are hauled by truck with a two-wheel trailer from the warehouse yard to the job. These trailers will haul 25 to 30 poles to a load. The line crew uses a gin hoist mounted on a truck to handle the pole when setting it up in the ground.

It is common practice for the warehouse personnel to load the materials which each line crew will use the next day onto their truck at night after the crew returns from their day's work. These materials are selected from stock piles during

(Continued on page 98)

Fig. 10. Setting a pole

Fig. 11. Overhead Line warehouse interior

Philip Sporn and Twin Branch To Have 200

Design for 9270 Btu per kwhr net output for proposed Philip Sporn Nos. 1 and 2 and Twin Branch No. 5 units. . . . Reheat cycle showed 5% better heat rate and 2% higher first cost than non-reheat. . . . Each generating unit cross-compound, 125,000 kw nominal, served by one 935,000 lb-per-hr steam generating unit of 90% efficiency. . . . Furnace designed for pressure operation at 15 in. H_2O; will try to operate without I.D. fans . . . Designed for optimum financial return, fuel economy, reliability

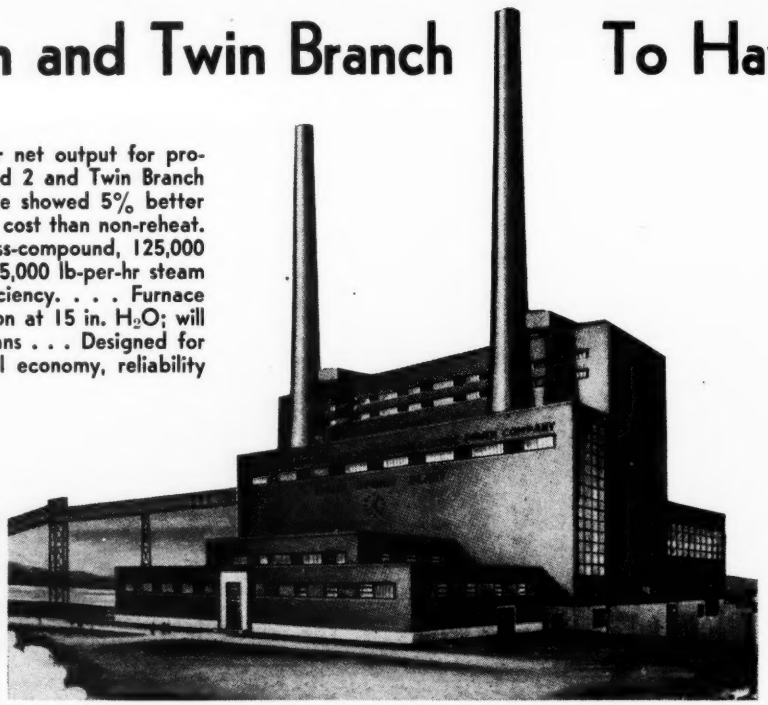


Fig. 1. Architects' rendering of new Philip Sporn Plant on Ohio River

AMERICAN GAS AND ELECTRIC power systems, and more particularly the Central System, have almost from their inception been concerned with the economical generation of steam-electric energy as the foundation for a soundly conceived and successful electric utility system. Elsewhere there have previously been described the developments at Philo, where a 600-psi, 725-F cycle with 725-F reheat was introduced in 1923; Deepwater, the first new station designed for 1250-psi operation; Logan, the first planned, post-depression, major topping operation; Twin Branch No. 3, the first successful 2500-psi installation in the United States; and Missouri Avenue No. 7, the first commercial 1000-F unit. In that cycle there definitely also belongs Tidd Unit No. 1, (see POWER PLANT ENGINEERING, March, 1947) which followed Twin Branch No. 3, but which, because of wartime exigencies could not take advantage of Twin Branch No. 3 experience and thus advance on that. Tidd No. 2, now under construction, likewise could not be designed as a forward step in generation technology—the need to get capacity on the line in the minimum possible period made substantial duplication almost mandatory.

But with the gain of a breathing spell brought about by construction of Tidd No. 2 and with the greater freedom to plan new facilities in equipment that the post-war period brought in, it became possible to try again to move forward on the front of economical energy generation by steam-electric processes. This, it is believed, has been at least partially accomplished successfully by the installations projected at Philip Sporn (Nos. 1 and 2) and at Twin Branch (No. 5) stations. In each of these cases effort has been directed to combine in optimum fashion the elements of site, cycle, fuel, and equipment.

In a paper before the Annual Meeting of the ASME, December, 1947, Philip Sporn, president, American Gas and Electric Service Corp., discussed these elements in detail. He reviewed first the considerations of site, fuel and equipment affecting economical design and operation, then discussed the reasons for capacity additions to the AG&E system to meet expected load requirements through 1950-51. The two latest of these are Twin Branch No. 5 and Philip Sporn Nos. 1 and 2, the latter an entirely new station.

Because Unit No. 5 at Twin Branch is similar from a standpoint of equipment, cycle, and basic arrangement, to the equipment, cycle, and arrangement followed at Philip Sporn, no space will be devoted to any discussion of these features at Twin Branch; the discussion given of Philip Sporn will apply almost equally well to the Twin Branch Station. Each unit at both stations will be of 125,000 kw nominal capacity and each served by a single boiler of 935,000 lb. per hr. capacity.

Philip Sporn Station, Location and Organization

Philip Sporn Station will be located on the Ohio River at the boundary of the two largest groups in the Central System—The Ohio Power Co. and Appalachian Electric Power Co. and is to be a joint station for those two companies.

The site itself consists of approximately 275 acres with 6000 ft. of frontage on the Ohio River. The contiguous coal reserves in Ohio and West Virginia amount to approximately 22,340 acres and an estimated 132,000,000 tons of coal, some under the river bed of the Ohio River. The river at that point is not only navigable with 9 ft. slack water navigation channel, but has a minimum flow of about 2200 cfs, so the site is adequate for the development of a plant at least three times the size of the present project. Furthermore, the coal reserves available give ample assurance of adequacy of economic coal supply. Developments in underground gastification, if they should materialize, can be exploited.

The Heat Cycle

The 2000-psi, 1050-F initial temperature, 1000-F reheat, cycle that was adopted is shown in Fig. 1. In developing this cycle the major objective was optimum financial return, taking into consideration not merely economy of fuel but also reliability, for fuel economy means little to a plant that is shut down.

The heat rate at a net plant output of 141,000 kw is estimated at 9270 Btu per net kwhr output with an expected 90 per cent boiler efficiency.

In comparative cost estimates of reheat vs non-reheat, reheat gave roughly 5 per cent better heat rate, with a higher first cost of about 2 per cent. This makes the reheat cycle for this station a most attractive investment.

Although the condenser is being designed for minimum condensate refrigeration and 0.03 cc per liter oxygen content at rated load, a deaerator to operate under positive pressure is being installed to insure thorough deaeration of the feedwater even under extreme load changes. Incremental cost of a deaerator over the equivalent closed

2000-psi, 1050-F and 1000-F Reheat Cycles

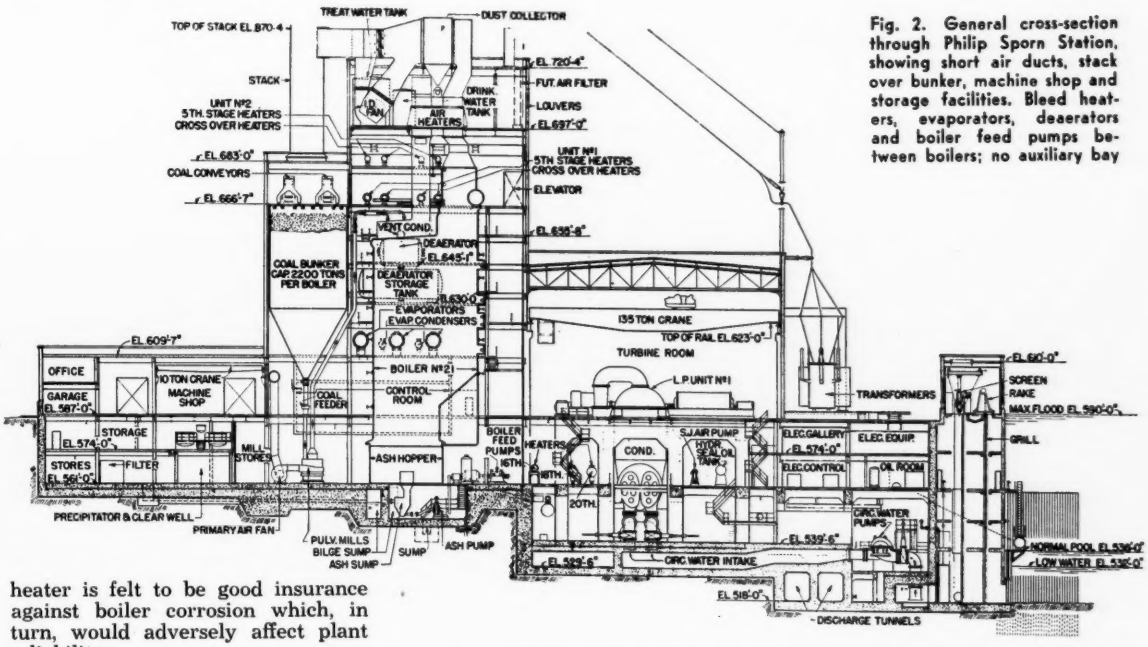


Fig. 2. General cross-section through Philip Sporn Station, showing short air ducts, stack over bunker, machine shop and storage facilities. Bleed heaters, evaporators, deaerators and boiler feed pumps between boilers; no auxiliary bay

heater is felt to be good insurance against boiler corrosion which, in turn, would adversely affect plant reliability.

The means used to cool the main generator is another example of the effort made to incorporate high reliability in the cycle. After leaving the condenser, a portion of the condensate is passed through the generator hydrogen coolers. The purpose is to preclude the frequent cleaning of the hydrogen coolers which would result if river water were used. A condensate cooler is provided in which river water cools the condensate to the degree required in the summer time.

Turbine and Its Features

The new cross-compound turbine is a new combination of high-pressure and low-pressure turbines. The 3600-rpm high-pressure element has a rating of 35,000 kw and a capability of 42,000 kw. Its throttle conditions are 2000 psig, 1050 F. The two emergency stop valves as well as the turbine inner shell will be chrome-nickel-moly, columbium stabilized. The turbine outer shell will be moly-vanadium.

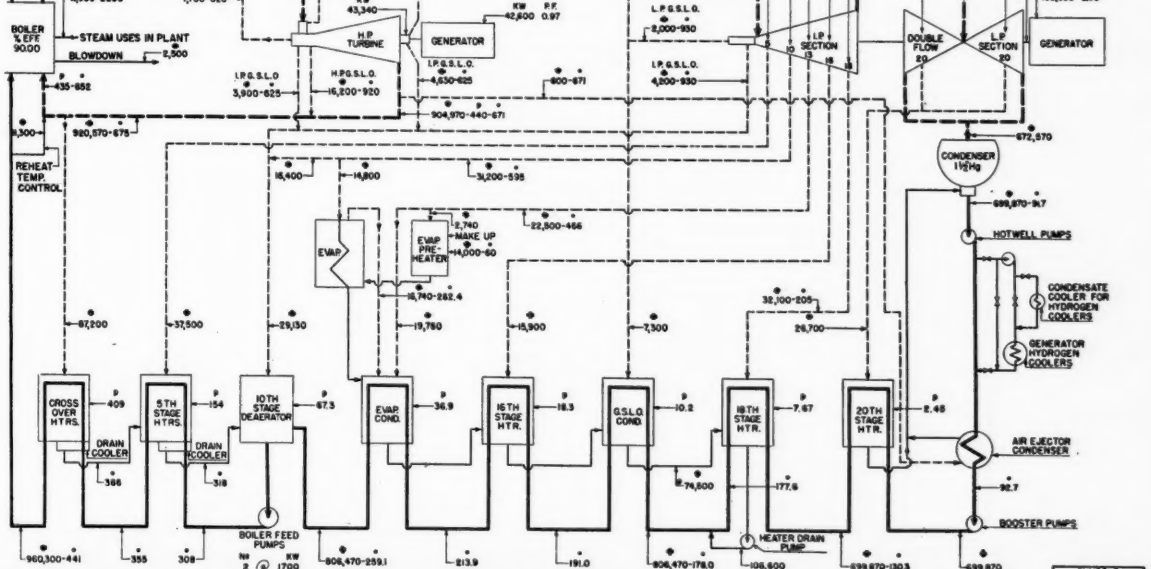


Fig. 1. Heat cycle, Philip Sporn Station Nos. 1 and 2 and Twin Branch Station No. 5, showing 2000 psi 1050 F cycle with reheat to 1000 F between high-pressure and low-pressure turbines. Note generator cooler details, deaerator and six stages of bleed feedwater heating

The 1800 rpm low-pressure element has an intermediate-pressure turbine in tandem with a double-flow low-pressure section. The whole is rated at 95,000 kw with a capability of 108,000 kw, and its generator will be almost identical with those at Glen Lyn No. 5 and Tidd No. 1 and No. 2. The intermediate-pressure section receives steam from the reheater at 375 psig, 1000 F, and exhausts at about 8 psia to the double-flow low-pressure section. Its high temperature parts will be of moly-vanadium.

Boiler Features

The total heat input of 1,300,000,000 Btu per hour to produce 150,000 kw gross generation, makes the boiler one of the largest projected anywhere. It is designed for maximum continuous steam output of 935,000 lb. per hr. at 2035 psig, 1050 F at the superheater outlet. A temperature of 1050 F will be maintained between 850,000 and 925,000 lb. per hr. by an attemperator between the primary and secondary portions of the superheater.

After passing through the high-pressure turbine, the steam will be exhausted at around 400 psi, and some 850,000 lb. per hr. will be returned at 650 F to the reheater, where it will be raised to 1000 F. This temperature will be maintained at 1000 F between flows of 750,000 and 850,000 lb. per hr. by an attemperator just before the inlet header to the reheater.

Flue gases discharged from the Ljungstrom air heaters go into the stack at about 235 F. The 12 in. long cold-end layer of the air heater will be made of Corten steel, which, together with recovery of air heated by boiler room radiation losses will resist corrosion caused by the low flue gas temperature.

Five coal pulverizers will be furnished for each boiler. There will be ten burners per boiler of the multiple intertube type. These fire vertically downward into the completely water-cooled tangent tube furnace. The furnace is divided laterally by a curtain wall of bare tubes.

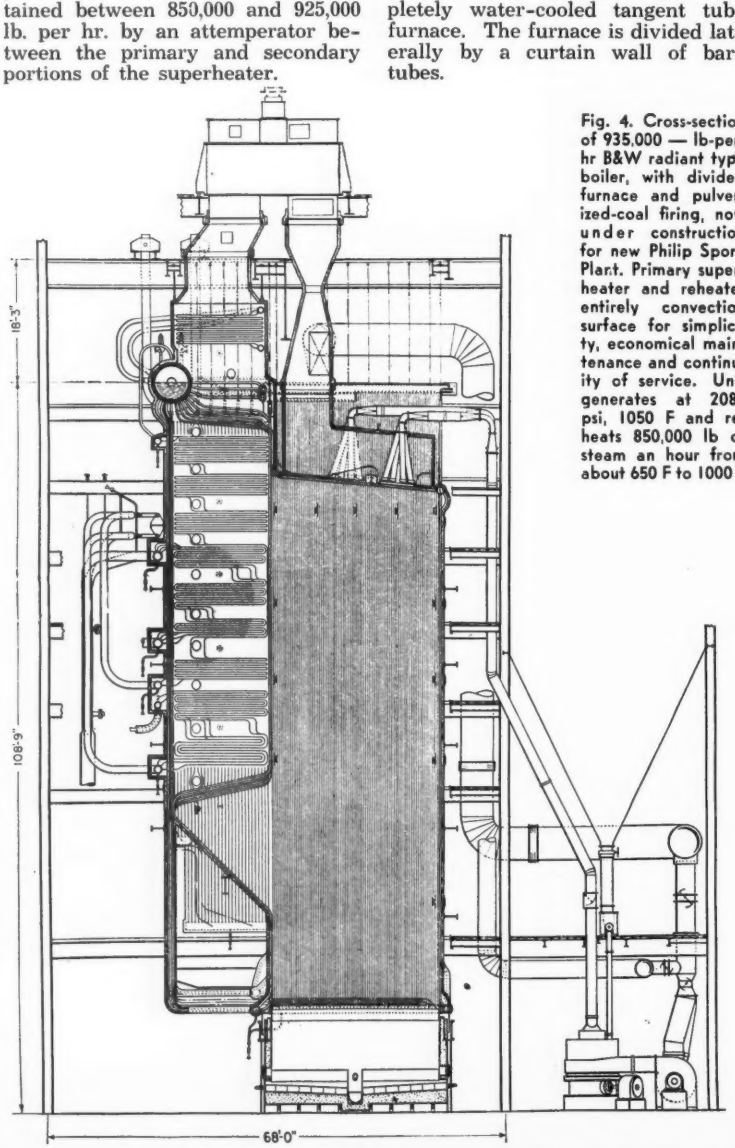


Fig. 4. Cross-section of 935,000 — lb-per-hr B&W radiant type boiler, with divided furnace and pulverized-coal firing, now under construction for new Philip Sporn Plant. Primary superheater and reheater entirely convection surface for simplicity, economical maintenance and continuity of service. Unit generates at 2080 psi, 1050 F and reheats 850,000 lb of steam an hour from about 650 F to 1000 F

Another outstanding feature will be the attempt to run without induced draft fans. To do this, the entire casing will be made tight for a furnace pressure of 15 in. of water. However, induced draft fans will be installed in case this forward step in the art of coal burning is not successful.

Electrical Arrangement

The electrical arrangement is extremely simple: a 3-phase 52,500 and two 62,500 kva, 3-phase transformers step-up the high-pressure generator and the 2 windings of the low-pressure generator to 132,000 v through a single switch to each of the two 132,000-v buses. No low voltage switches or buses are employed. Auxiliary power is furnished by two 6000/8000-kva transformers connected one to each of the low-pressure generator windings and stepping down to 2300 v. Seven feeders at 132,000 v take the output of the station to the system. Each of these is switched through a single oil switch operable on either the main or the reserve bus.

Special Features

High thermal efficiency means little to a plant that is shut down. Availability must be inherent in the design of the equipment and its layout in the plant rather than merely providing a duplicate or a spare. True, availability must be correlated closely with plant investment as too much can be spent to avoid an outage. After all, the plant *is* connected to a highly developed and reliable transmission system.

Since coal from a strip mine must often be accepted, a straight down spout from the coal bunker to the pulverizer mill feeder will preclude hang-ups. No coal scales will be installed for individual boilers, but all incoming coal for the entire station will be weighed while on the belt.

It is trite to say that a clean plant is usually an efficient plant and makes for low maintenance cost. Special effort is made to design for a clean plant in the many little design details in which this can be done. For example, a major source of dust and dirt within a plant is the expansion joints in the hot air ducts between Ljungstrom air heaters and the burners. In the Philip Sporn plant, all hot air ducts under pressure will be welded, and bellows-type expansion joints will replace the usual slip-type joints.

Full condenser back-washing will be provided, for the Ohio River becomes extremely turbid after heavy rains. Long experience with other stations on that river has indicated that revolving screens are insufficient to cope with keeping condensers in operation under such conditions. It is possible to reverse the flow completely through each half of the condenser.

Chemical Feed Systems in Modern Water Treatment

Part II—Chemical treatment now applied to practically all water supplies . . . Proper application has necessitated development of many types of chemical feeders and feed systems . . . Part I, in August issue, covered wet or solution-type feeders and constant-rate feeders . . . This article, second of two parts, deals with proportional feed systems and dry-type feeders . . . Details of pot-type, positive displacement pump, electric-motor-driven pump, meter and timer-controlled pumps and the thymotrol system are given, also hydraulic types and double-orifice feeders . . . Volumetric and gravimetric dry types of feeders

By **JAMES H. RICHARDS,** Chemical Engineer, W. H. & L. D. Betz

FOLLOWING is a detailed discussion of proportional feed systems and dry type feeders, a continuation of the article on chemical feed systems that began in the August issue.

Pot Type Proportional Feeds:—Probably the simplest type of proportional feeder is the pot type feeder with a special opening in one end to permit charging with chemicals in briquette or lump form. A portion of the water to be treated is allowed to pass through the tank, gradually dissolving the chemicals. Feeders of this type are used for continuous and proportional feed of treating chemicals to boiler feedlines for protection of feedlines and boiler water conditioning, to hot and cold water distribution systems and various types of cooling systems.

The degree of proportionality is questionable at all times, for there is little control over the solution rate of the briquettes or of the chemicals incorporated in them. This system, while it is classified as proportional, is considered only roughly so and cannot be applied where appreciable accuracy of feed is required.

A further adaptation of the pot type proportional feeder is the type commonly used to proportion alum and alkali to water systems for coagulation, or for oil removal in feedwater systems. This system also consists of a pot in which potash alum or ammonia alum, in lump form, or sal soda (crystalline sodium carbonate) are placed. An orifice is installed in the raw water line, and a line from the upstream side of the orifice leads to the under-side of the tank. From the topside of the tank, a discharge line returns to the water line just after the orifice. The resulting pressure differential causes a small stream of water to flow through the pot feeder, gradually dissolving the crystalline chemicals contained therein and introducing the treating chemicals to the water line.

This type feeder is roughly proportional and can be used in any installation where accurate proportioning is not necessary and where the chemicals to be fed are obtainable in large crystalline or lump form. Dry or powdered materials cannot be used in a feeder of this type.

Positive Displacement Type Pump:—Pumps are available that can be driven by a ratchet arm connected to a reciprocating pump or engine. These pumps can also be driven by a belt and pulley for connection to centrifugal type pumps. By so connecting either type of pump, feed of treatment is accomplished in proportion to the flow of water through the pump. Such a system is quite suitable for the continuous and proportional feed of chemicals to boiler feedlines, once-through cooling systems, and the like.

Electric-Motor-Driven Pumps:—An electric-motor-driven positive-displacement pump can be used to provide proportional feed of chemicals to a well supply under certain conditions. The chemical pump can be controlled by the same electrical circuit that operates the well pump, so that the chemical pump operates only when the well pump is operating. Where several well pumps are used, the system may not be applicable. A system of this nature, when adaptable, provides accurate proportioning of chemicals for treatment of the well water for prevention of corrosion, scale formation and to retain iron in solution.

Meter and Timer Controlled Pumps:—This system utilizes a water or steam meter equipped with an electrical contacting device that makes contact after passage of a specific amount of steam or water in the lines. Upon each contact, a stop-cycle timer is started, which operates a complete cycle. The timer is adjusted to permit the operation of the motor-driven pump a pre-set number of minutes for each contact. The time cycle is readily adjustable to provide flexibility. For the application of chemical treatment to boiler water, the control system is applied to steam, feedwater or make-up water meters. The system is usually established so that the pump will operate approximately 75 per cent of the total time, allowing ample capacity for emergencies and unusual demands on the system.

This type of system is not entirely

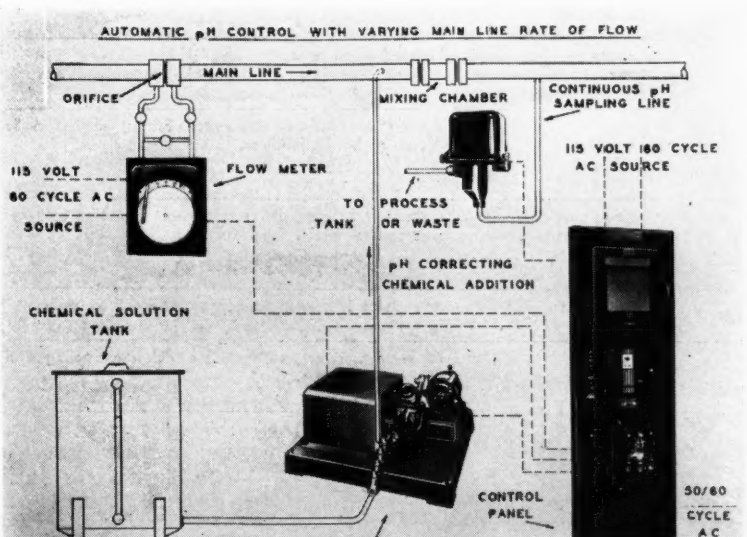


Fig. 1. Typical application of electronic proportioning control, for automatic control of pH with varying main line rate of flow

suitable for proportional feed of treatment to once-through systems unless the treatment is injected ahead of a large storage tank where adequate mixing can be accomplished. Also, for proportioning phosphates and other treatment chemicals direct to the boiler drums, it is necessary to supply a meter, timer, and pump for each discharge point; this makes such an installation rather expensive. The accuracy of proportional feed is also affected if the amount of condensate available is variable and a feedwater meter or a steam meter is used for control. Also, if make-up water characteristics are changeable, boiler water balances may prove to be

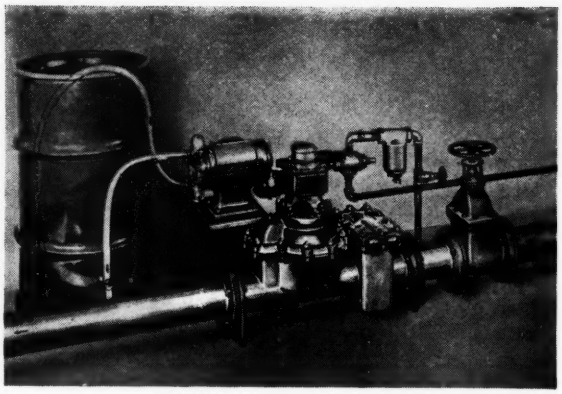
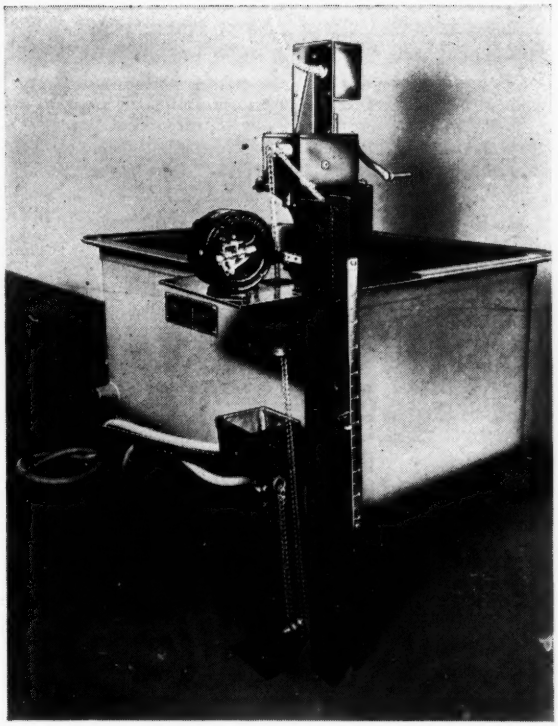


Fig. 2. Installation of meter-controlled hydraulic type proportional feeder (% Proportioneers, Inc %. photo)

Table listing more common water treatment chemicals and methods of feeding them

CHEMICAL	PROCESS USE	TYPE FEEDER	POINTS OF APPLICATION
Alum	Coagulation Color Removal	Dry Pot Type Proportional Double Orifice Decanting Pumps	Coagulation and sedimentation Systems; prior to pressure filters for removal of suspended matter and oil.
Sodium Aluminate	Coagulation	Decanting Pumps Shot Feeders	Usually added with soda ash to softeners; used to some extent for internal boiler water treatment.
Ferric Salts	Coagulation Color Removal	Decanting Double Orifice Pumps	Prior to coagulation and filtration systems.
Lime (Hydrated)	pH adjustment Softening	Decanting Special Pumps (Slurry) Dry	Prior to Coagulation systems; to softeners; to treated water lines for adjustment of pH.
Soda Ash (Crystalline)	pH adjustment	Pot Type proportioning	Prior to pressure filters.
Soda Ash (Anhydrous)	pH and alkalinity adjustment Softening	All types of wet and dry feeders	To domestic systems, feedlines, softeners, coagulation and filtration systems; boilers.
Caustic Soda	pH adjustment Alkalinity adjustment Softening	All types of solution feeders	To softeners; oil removal systems; domestic water systems; boilers.
Acid Feed (H_2SO_4) (H_3PO_4) ($NaHSO_4$)	pH adjustment Reduction of alkalinity	Decanting Pumps	Treated water lines, prior to degassifiers or deaerating heaters; H_3PO_4 to phosphate softeners (for both softening and alkalinity reduction).
Surface Active Phosphates	Prevent calcium carbonate deposits Eliminate "red water"	All types of proportional solution feeders	Treated water lines.
Ortho-phosphates (Monosodium Phosphate) (Disodium Phosphate) (Trisodium Phosphate)	Prevent scale in boilers	Pumps Shot feeders	Added continuously to boiler drums; shot fed to drums or boiler feedline.
Sodium Sulfite	Prevent Corrosion due to oxygen in boilers, feedlines, economizers	All types continuous solution feeders	Storage section of deaerating heater; suction or pressure side of boiler feed pumps.
Sodium Nitrate Sodium Sulfate	Inhibition of embrittlement	All types of solution feeders	Any point in boiler feedlines or direct to boilers.
Sodium and Potassium Chromates	Corrosion Inhibitor	All types of solution feeders	To brine systems and various circulating cooling and hot water systems.
Reactive Colloids (Sodium Manuronate) Protective Colloids (Starches) (Tannins)	Coagulation Particle Absorption and adsorption	All types of solution feeders	To boiler feedlines; boilers; circulating cooling systems.
Amines and Related Organic Compounds	Prevention of return line corrosion	Shot Feeders Pumps	Application depends upon material used. Some materials may be added to boilers and volatilize with steam; others are added to steam line direct, requiring pumps.



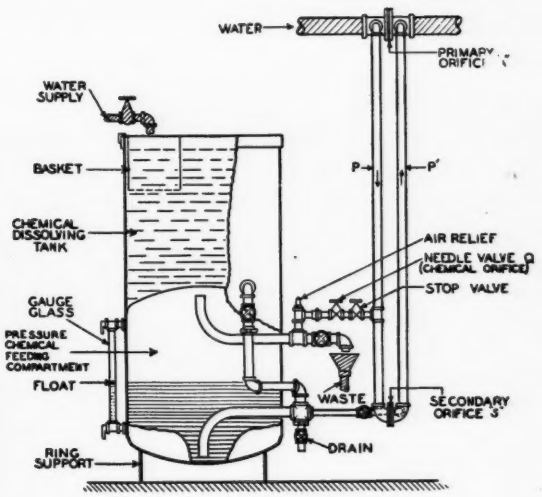


Fig. 4. Above. Construction and connections of double-orifice type proportional feeder

Fig. 3. Left. Decanting type proportional feeder (American Water Softener Co. photo)

quite variable even though treatment is added proportionally.

Another variation of this type of system permits the motor-driven pump to operate continuously. A meter controls the timer, as before, but in this instance the timer controls the functioning of a three-way valve. Depending upon the time cycle, the three-way valve permits chemical solution or condensate to flow to the suction of the chemical pump.

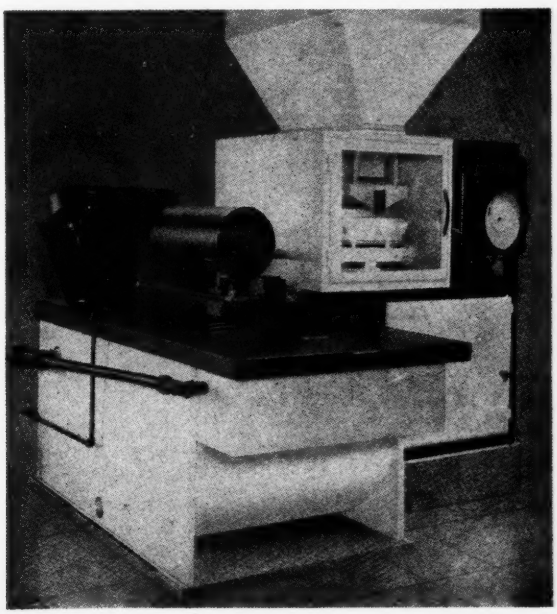
It is supposed that this system prevents plugging of the chemical feedlines by flushing periodically with condensate. However, considerable maintenance is usually involved with operation of three-way valves. If the chemical solution is made up originally with condensate and the solubility of the chemicals used is not exceeded, no difficulties will be experienced with plugging of chemical feedlines. In addition, the chemical feedline must be properly located within the boiler drum, in order to further prevent the possibility of plugging of the line.

Thymotrol:—An electronic system employing the Thymotrol, as developed by the General Electric Co., has been adapted to the regulation of positive-displacement type pumps. Alternating current available at the plant is converted to direct current, full wave rectification being employed. A potentiometer is mounted in the water meter and governs the speed of the direct-current motor operating the pump. The setting of the potentiometer is immediately changed with any change in rate of water flow. Since the speed of a

(Continued on page 118)

Fig. 6. Right. Gravimetric feeder and lime slaker (Omega Machine Co. photo)

Fig. 5. Below. Installation view of volumetric dry feeders. (Infilco, Inc. photo)



This article discusses the significance and importance of magnetic alloys having rectangular hysteresis loops in the design of contact rectifiers and magnetic amplifiers. It deals especially with alloys of the iron-nickel and iron-nickel-cobalt series developed in Germany during the war and used at the Haraeus Vacuumschmelze A. G. While the material in this article was presented at the Winter meeting of the American Institute of Electrical Engineers in Pittsburgh in January 1948, it was issued for limited circulation as a Naval Ordnance Laboratory Memo. The photographs and editorial notes were supplied by the Naval Ordnance Laboratory at White Oak, Md.

German Magnetic Alloy Has Important Applications

By G. W. ELMAN and E. A. GAUGLER
Naval Ordnance Laboratory, White Oak, Maryland

ALTHOUGH magnetic materials possessing substantially rectangular hysteresis loops have been known for some time, only recently has this property been utilized in the design of electrical apparatus. One of the earliest applications is for saturable reactors used in *contact* rectifiers. These rectifiers were developed in Germany during the war, and have been in commercial use there since 1943.[1]

Another application of this type of material is for magnetic amplifiers. Development work on these amplifiers has been under way for some time at the U. S. Naval Ordnance Laboratory. The results so far obtained show that superior service can be obtained when magnetic cores with rectangular hysteresis characteristics are used. While these are the outstanding applications up to this time, it is believed that when the full significance of the rectangular hysteresis loops is appreciated by designers of electrical apparatus, more useful applications will be found, particularly in the design of saturable devices and equipment operated at high flux densities.

Mechanical Rectifiers

Attempts in the past to construct mechanical rectifiers have been frustrated because of the difficulty encountered in commutation.

In order to obtain satisfactory results, the commutation must take place while the current passes through the zero value. In an or-

[1] See Contact Rectifiers. POWER PLANT ENGINEERING, July 1947, page 107. Also, A Mechanical Rectifier, POWER GENERATION, April 1948, page 58.

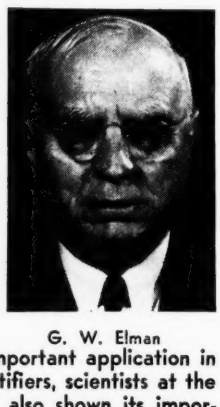
Those who were interested in the article, A Mechanical Rectifier, which appeared on page 58 of the April, 1948 issue will be interested in this article on magnetic alloys because it was the reproduction of these originally German materials that made the production of these mechanical rectifiers possible in this country.

Unfinished samples of this alloy, now known as Permenorm 5000-Z, were found in Germany by allied technical missions shortly after V-E day. These samples were distributed to governmental and industrial laboratories in the United States to be duplicated for American use. Although details of the process were available, at first the metal could not be duplicated because of the intricate heat treating process required. Many organizations were able to reproduce the metal, but their finished products did not demonstrate the required magnetic properties.

E. A. Gaugler

At the Naval Ordnance Laboratory, however, scientists not only succeeded in duplicating the German process but have developed a more satisfactory process for adapting the material to modern mass production techniques. The Laboratory now has in production small quantities of the alloy which will be sufficient to permit ordnance contractors to build experimental ordnance equipment to eventually replace the heavier and more inefficient devices now in use in the Fleet.

The alloy, resulting from a fusion of nickel and iron under an intricate heat treating process, was first synthesized in 1943 in Germany where it was immediately applied in the electrochemical industry in the construction of huge rectifiers.



G. W. Elman

While Permenorm 5000-Z has important application in the construction of mechanical rectifiers, scientists at the Naval Ordnance Laboratory have also shown its importance in the design of magnetic amplifiers. In this application it becomes possible to replace many complicated, delicate and troublesome electron tube amplifiers used in guided missiles, fire-control equipment, and underwater ordnance.

Credit for the development of this very important alloy goes to Dr. Gustaf W. Elman and Edward A. Gaugler, physicists at the Naval Ordnance Laboratory. Dr. Elman who is known for his work in the field of magnetic material, acted as consultant on the project, while Dr. Gaugler was actively in charge of the development.

dinary a-c wave the rate of change is the greatest at that point. As a result there is no time for commutation, without destructive sparking. When saturable reactor coils are put in series with the current leads, a "step" is introduced as the current passes through substantially zero value. This prolongs the time of zero current so that almost sparkless commutation can be obtained. It has been found that far superior results are obtained if these saturable reactor coils have rectangular hysteresis characteristics.

A basic circuit for a three phase contact rectifier is shown in Fig. 1. The saturable reactor coils are shown together with the windings used to aid in the development of sparkless commutation.

Figure 3 shows the load current (a) when the saturable reactors are not in the circuit and (b) when they are included as in Fig. 1. In the latter the step in the current wave is shown.

Figure 4 shows the hysteresis loops for two cores of the same material. Core (A) has been heat treated by standard methods and Core (B) is specially processed to give a rectangular hysteresis loop. The commutation takes place at the steep portion of the hysterisis loop

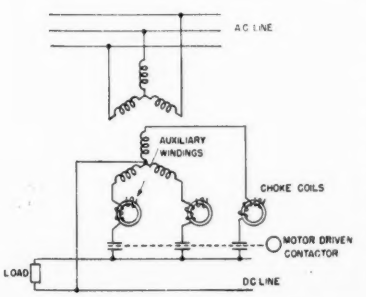


Fig. 1. Basic circuit of mechanical rectifier

When the width of the loop is small the current during commutation will remain small but not zero. In order to reduce the current step to zero an a-c biasing current is supplied through the auxiliary windings. Also it is desirable that the vertical portions of the hysteresis loops be as steep as possible, and that they approach the saturation value. This extends the commutation interval and minimizes the amount of core material for a given rectifier. Materials which have rectangular hysteresis loop as shown in (B) Fig. 3 fulfills these requirements.

Mechanical rectifier units having capacities up to 10,000 amp and 400 v d-c have been produced commercially. They are reported to have an overall efficiency of 97-98 per cent.

Development work at the Naval Ordnance Laboratory has shown that certain advantages in the construction of magnetic amplifiers are obtained by the use of magnetic materials with rectangular hysteresis loops.

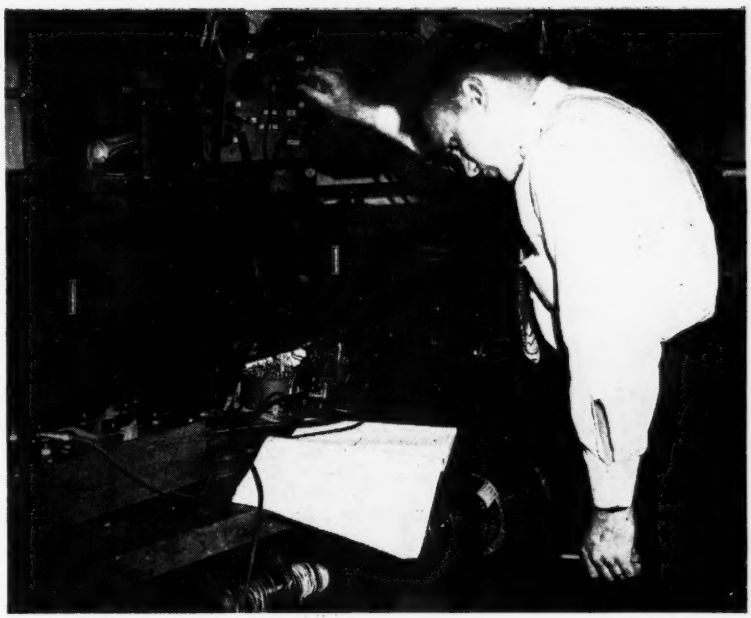


Fig. 2. Arthur O. Black, engineer at Naval Ordnance Laboratory testing a magnetic amplifier which uses Permenorm, the new magnetic material reproduced after the German development, at the Naval Ordnance Laboratory

One type of magnetic amplifier circuit employing regeneration is shown in Fig. 5. Saturable transformers T_1, T_2 are designed to operate at the knee of the magnetization curve. Because the regeneration is accomplished by the flow of the rectified load current through a feedback winding, a d-c bias is required to minimize the load current at zero signal. When a signal is applied, each transformer is driven into saturation. This increases the magnetizing and load currents.

From power considerations, it is desirable to operate at high flux density. The higher the density at which the knee occurs, the larger will be the output power capacity of a coil with a core of a given size. Also, in order to increase the amplification, the magnetizing force at the knee should be as small as possible. In a material having a rectangular hysteresis loop, the knee occurs very close to saturation value. Because of that, the form factor of the load current more nearly approaches that of a sine wave. Figure 6 shows the magnetization curve of two nickel-iron alloy cores of substantially the same composition. Core B has been given a special treatment to produce a rectangular hysteresis loop while Core A has been given the standard heat treatment. Figure 7 shows the current wave form for each of these cores, showing improved sinusoidal characteristics of the specially treated material. An amplifier constructed with identical cores of these materials delivered over twice as much

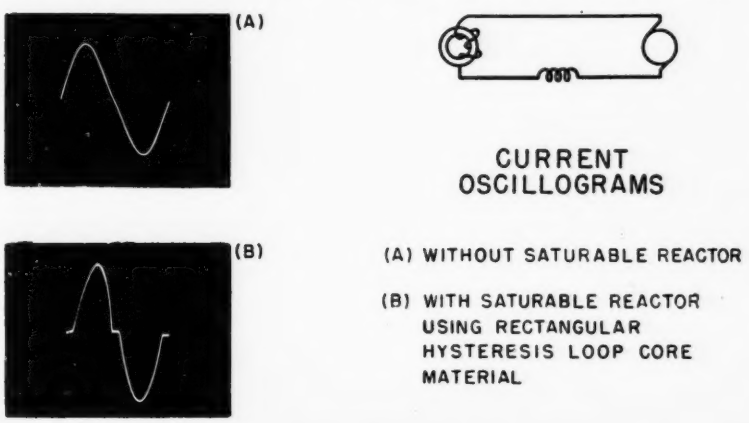


Fig. 3. Oscillograms taken with and without saturable reactor

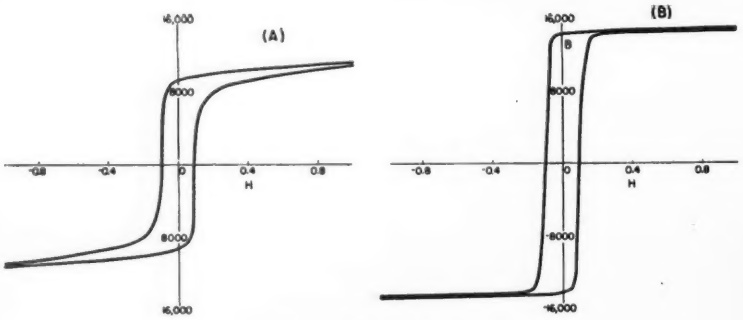


Fig. 4. Hysteresis Loops
50% Ni, 50% Fe Alloy

(A) Standard Anneal. (B) Special Anneal after drastic reduction

power when Core B was substituted for Core A. Furthermore, the gain is more constant over the entire operating range of the amplifier as shown in Fig. 8.

Rectangular Hysteresis Loops

One method of fabricating magnetic alloys with rectangular hysteresis loops is by drastic cold rolling and final special annealing. This method was developed for the production of cores for the mechanical rectifier by the Haraeus Vacuumschmelze A.G.

The alloy consisted of equal portions of nickel and iron in which special precautions are taken to reduce impurities both in regard to those introduced by the raw materials and by the melting operations. By melting and casting in vacua and subsequent annealing at high temperature in pure dry hydrogen, further purification results. By these methods, the oxygen and carbon content of the alloy is reduced below 0.01 per cent. The ingots are hot rolled down to 0.24 in. thick. They are reduced to final size by cold rolling without further annealing below 0.10 in. This amounts to a 98 to 99 per cent reduction. The sheets are slit into the desired width of tape at 0.014 in. It is claimed that if the slitting is done after the final rolling the magnetic characteristics are affected adversely.

The final tape either 0.0012 in. or 0.002 in. thick is insulated and wound into spiral cores by standard methods. These cores are heat treated in hydrogen at temperatures between 1000 and 1150 C. The charge is loaded into a superheated furnace, held for two hours, and cooled rapidly. The optimum temperature is determined magnetically for each heat using small test samples. Figure 9

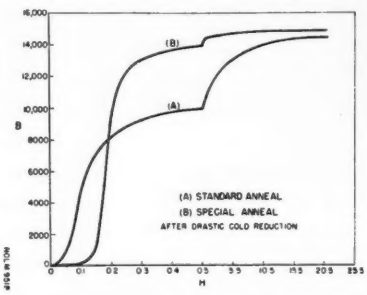


Fig. 6. Magnetization Curves of 505 Ni, 50% Fe alloy

shows hysteresis loops of this material annealed under similar conditions at three different temperatures. The alloy represented by curve C was annealed at an excessively high temperature and shows magnetic characteristics similar to the standard alloy of the same composition.

Another method of producing rectangular hysteresis loop is by heat treating in a magnetic field. Published reports by Bozorth and others of the Bell Telephone Laboratories show that 69 permalloy and some of the perminvar alloys have rectangular hysteresis loops when cooled in a magnetic field. The result of recent tests at N.O.L. on the perminvar alloy containing 7 per cent cobalt, 70 per cent nickel and 22.4 per cent iron and cooled in a magnetic field is shown in Fig. 9.

Recently Dr. Mihara in Japan has found that if very pure silicon steel is cooled in a magnetic field, rectangular hysteresis loops can be obtained. He was not able to obtain a residual induction as close to saturation as is possible with the other alloys as shown in Fig. 11.

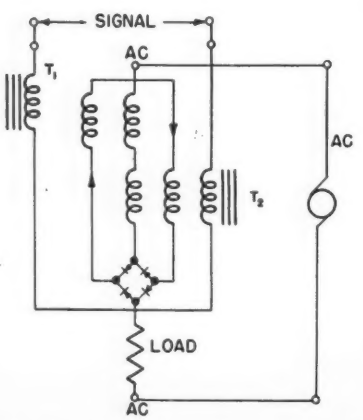


Fig. 5. Magnetic amplifier circuit with regeneration

Core Design

In order to effectively utilize these magnetic characteristics in an actual transformer, it is essential that certain precautions be taken. Although these fundamentals are well known, they are not considered essential to standard transformer design practice and therefore are not generally adhered to. It is essential that air gaps in the magnetic circuit be minimized in order not to shear over the hysteresis loop. This limits the core design to uncut wound cores or ungapped punchings. Although the fundamental excitation frequency may be low, the transit time during

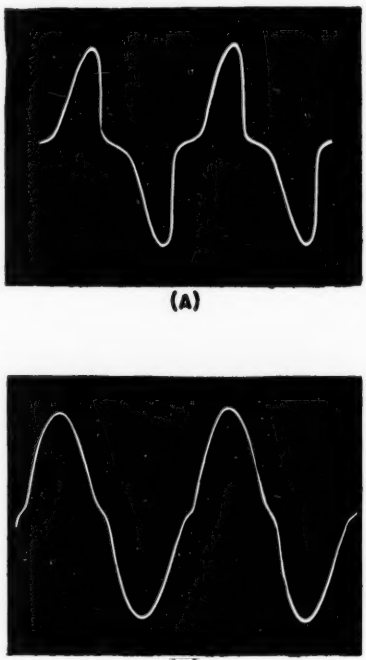


Fig. 7. Oscillograms showing output current of magnetic amplifier (A) Using standard core material. (B) Using rectangular hysteresis loop material

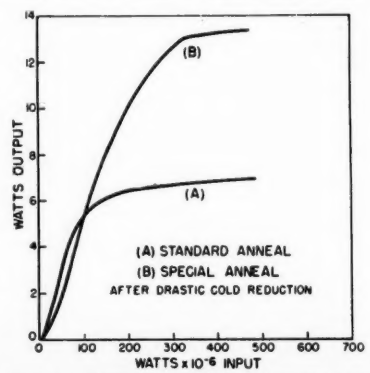


Fig. 8. Magnetic amplifier characteristics of 50% Ni, 50% Fe alloy

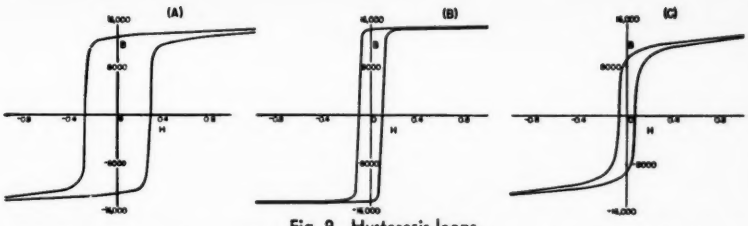
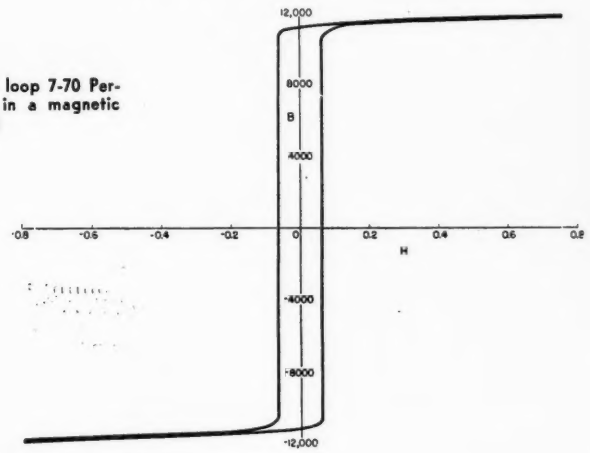


Fig. 9. Hysteresis loops
50% Ni, 50% Fe alloy. Drastic cold reduction, annealed for 2 hours at (A) 975 C. (B) 1100 C. (C) 1175 C.

Fig. 10. Hysteresis loop 7-70 Perminvar. Annealed in a magnetic field



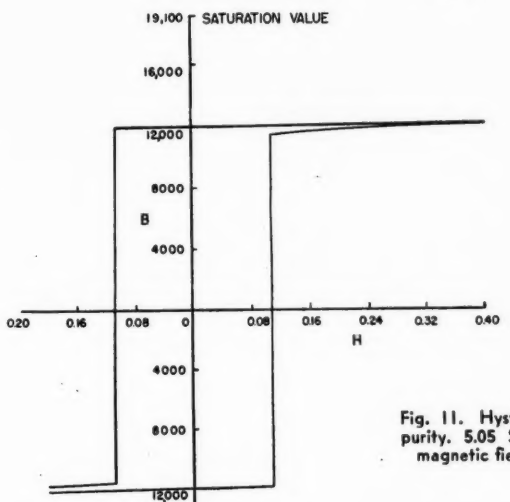


Fig. 11. Hysteresis loop of high purity. 5.05 Si-Fe. Cooled in a magnetic field of 0.3 Oersteds

Fig 12. Miss Elizabeth Davis, physicist at the Naval Ordnance Laboratory testing the magnetic properties of a toroidal core

reversal of saturation may be exceedingly short and consequently the specific resistance of the material should be high and the material thickness a minimum. For example, in the mechanical rectifier operating at 50 cycles, the transit time was approximately one millisecond, tape thickness 0.0012-0.002 in., specific resistance 45 micro-ohm centimeters. Because of difficulties encountered in punching thin material, spirally wound cores are preferred.

Other precautions must be taken in order to obtain a sharp knee in the magnetization curve. One is that the magneting force be uniform over the entire cross section of the core. This implies a relatively narrow annular width. Another is that after the final heat treatment care must be taken to prevent mechanical strains. These cores are therefore mounted in annular aluminum troughs with plastic covers to support the windings.

2d UNDERGROUND COAL GASIFICATION TEST

APPROVAL of a contract between the Bureau of Mines and the Alabama Power Co. for a second and larger cooperative experiment in underground coal gasification at Gorgas, Ala., was announced recently by James Boyd, Director of the Bureau.

The initial joint experiment last summer showed that gases produced by burning unmined coal offer a potential source of fuel for power and raw materials for synthetic liquid fuels. If proved feasible, underground gasification offers alluring possibilities for minimizing expensive mining and for utilizing coal veins difficult or uneconomic to mine.

Cost of the large-scale field test, including Bureau expenditures and those of the company which are reimbursable, is estimated at $411,000 for a one-year period. Under the contract, the company will provide engineering and operating services on an actual cost basis (without profit), and will contribute as a site for the experiment some 300 acres of Pratt seam coal averaging 40 inches in thickness.

Preliminary core drilling already is in progress to determine the composition of the ground overlying the coal, which ranges from 60 to 125 ft in depth. The next phases of the site-preparation job to be undertaken will be the drilling of five large-diameter holes to the coal bed and the driving of two parallel entries, 1,200 ft from the coal outcrop into the bed and a single butt entry

Those in charge of the new experiment will be Milton H. Fies, consulting engineer and manager of coal operations for the Alabama Power Co., and James L. Elder, chemical engineer, Bureau of Mines.

Because of great development in hydraulic and magnetic drives in recent years, author feels variable-speed economically justifiable today . . . In many cases, they will save $10 to $11 per hp . . . In similar study in 1943, author concluded variable-speed operation of boiler feed pumps not economically justifiable unless and until better 3600-rpm variable speed drives made available . . . Now, however, with such better equipment at hand, he re-examines his previous conclusions . . . Study shows how much can be paid for variable-speed drive to justify its application . . . Comparison made between same pumps as in first study—440,000 lb per hr, full load total head 2307 ft, temperature 316 F—with given station characteristics, efficiencies and load

Do Variable-Speed Drives Pay on Centrifugal Boiler Feed Pumps?

By **IGOR J. KARASSIK**, Assistant to Manager, Centrifugal Pump Division, Worthington Pump & Machinery Corp.

STUDY of the relative merits of constant and variable-speed motor drive for centrifugal boiler feed pumps was carried out by the author in 1943, and the results published in an article entitled "Motor Driven Boiler Feed Pumps . . . Constant or Variable Speed?" in the December 1943 issue of POWER PLANT ENGINEERING. The comparison was carried out between pumps driven at 3600 rpm by squirrel-cage motors and at 1800 rpm by wound-rotor motors, which, of course, are not economically available at 3600 rpm. Conclusions from that study were that until reliable and less expensive 3600-rpm variable-speed drives were made available, variable-speed operation of motor-driven boiler feed pumps was not economically justifiable.

Strides taken in recent years in the progress and development of variable-speed drives such as the hydraulic coupling and the magnetic drive have led to the need for a re-examination of the facts presented in the earlier sutdy. The following extension of the study will therefore be based on comparison of two- 3600-rpm pumps, of which one is to be operated at constant speed and the other is to be directly connected to a 3600-rpm squirrel-cage motor by means of a hydraulic coupling or other means of obtaining variable-speed operation. Furthermore, instead of attempting to determine whether the variable-speed installation is justified economically, the present study will establish what is the approximate price that can be paid for this drive to justify its application.

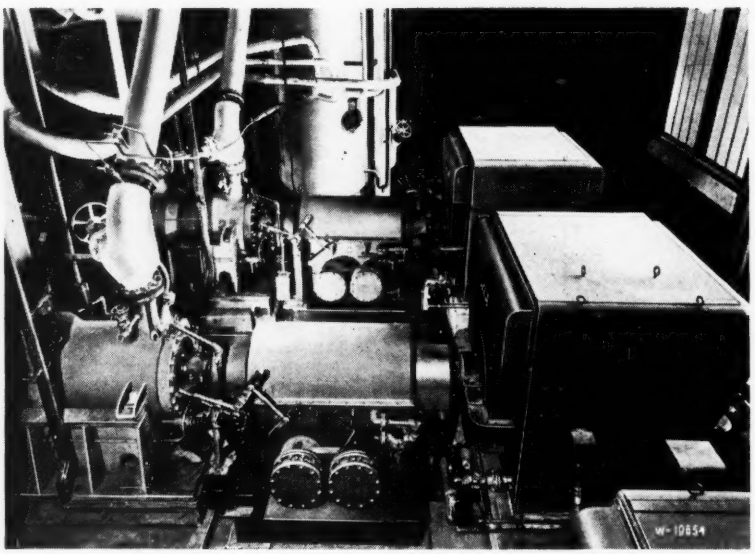


Fig. 2. Typical installation of high-pressure boiler feed pumps driven at variable speed through hydraulic couplings

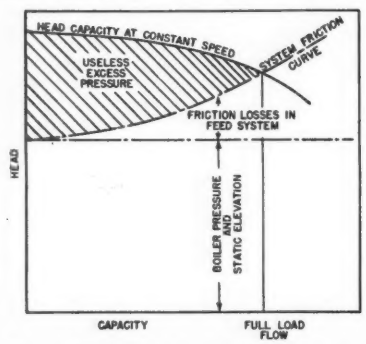


Fig. 1. Hydraulic characteristics of typical boiler feed system

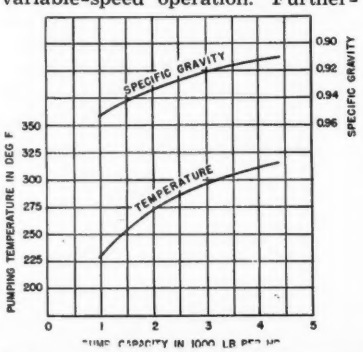


Fig. 3. Assumed load characteristics curve of station discussed in text example

Power Savings Comparison

General considerations entering into the problem of comparing variable and constant speed boiler feed pump operation may be found in the article referred to above. It will suffice to summarize these considerations by stating that the pressure generated by a centrifugal pump at constant speed increases with a decrease in capacity, the rise in pressure between full load flow and shut-off conditions ranging anywhere from 10 to 30 per cent. On the other hand, the pressure required to feed the boiler has the

general characteristics of a system head curve, decreasing appreciably with a reduction in flow. The difference between the pressure required to feed the boiler and that generated by the pump, as in Fig. 1, must therefore be considered useless—and must be absorbed by throttling or eliminated by variable-speed operation.

The service conditions selected to carry out the comparison between the two methods are identical with the two cases presented in the earlier article. In the first case, the design pump capacity was selected at 440,000 lb per hour at a full load temperature of 316 F. The required total head at full load was 2307 ft. The assumed load characteristic curve of the station is illustrated in Fig. 3 and the performance of a 3560-rpm, constant-speed pump in Fig. 4. The efficiency of the 700-hp squirrel-cage motor was taken as 0.94, 0.93 and 0.91 at full, ¾ and ½ load respectively. It was assumed that power costs average 0.5 cents per kwhr. Finally, a total yearly operating load of 8000 hr was selected, subdivided as follows:

Lb per hr	Operating hr per year
440,000	500
300,000	5500
200,000	1500
100,000	500

Based on an assumed system head curve, the performance of the variable speed unit is shown on Fig. 5. It was assumed that the variable-speed drive has a slip of 3 per cent at full load and additional losses represent another 1 per cent, so that the efficiency of the drive at full load is 96 per cent. The speed of the pump at full load is therefore 97 per cent of 3560 or 3453 rpm and it was further assumed that the performance of the pump remains as on Fig. 4 by vritue of increasing the impeller diameter to compensate for the decrease in speed. The "real horsepower" at variable speed represents the pump brake horsepower divided by the drive effiicency at the corresponding speed, since this efficiency is reduced proportionately to the speed at which it is operating and, therefore, the actual motor horsepower is greater than indicated

(Continued on page 126)

Table I. Summary of performance data for 3600-rpm constant-speed pump of Fig. 4

Lb per Hr.	Temp. Deg F.	Specific Gravity	GPM	Total Head in Ft	Eff. in %	BHP	Kw Input
440,000	316	0.91	970	2307	76	675	536
300,000	296	0.922	650	2600	70	562	450
200,000	272	0.933	429	2670	57	474	382
100,000	228	0.953	210	2700	35	392	320

Table II. Summary of performance data for variable-speed pump

Lbs Per Hr.	GPM	Total Head in Ft.	Pump RPM	Pump Speed in %	Pump Eff. in %	BHP	Drive Eff. in % *	Real HP	Kw Input
440,000	970	2307	3453	100	76	675	0.96	703	559
300,000	650	2245	3230	93.3	71.5	475	0.896	530	425
200,000	429	2200	3128	90.6	59	372	0.87	428	348
100,000	210	2200	3123	90.45	37	300	0.868	346	284

* Based on 3 per cent slip at full load and 1 per cent additional Losses (Control—Current, Windage and Friction).

Table III. Comparative operating data for two drives discussed in text example

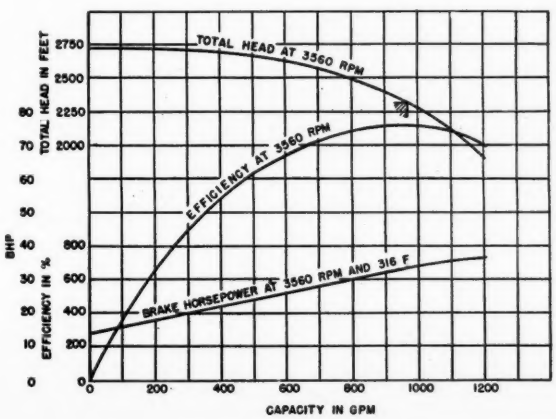
Lbs Per Hr.	Savings in Kw by Use of Variable Speed	Operating Hours per Year	Savings in Kwhr per Year
440 000	— 22	500	— 11,000
300,000	+ 25	5500	+ 137,500
200,000	+ 34	1500	+ 51,000
100,000	+ 36	500	+ 18,000
TOTAL		8000	+ 195,500

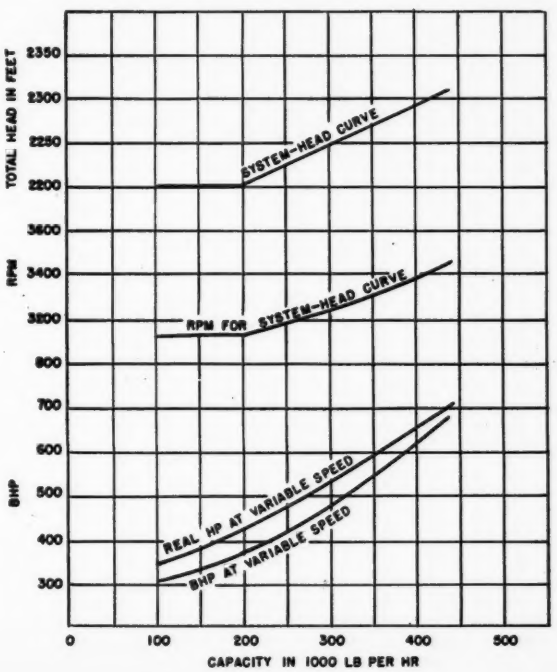
Table IV. Recovery of heat through throttling excess pressure on constant-speed pump of example

Lbs Per Hr	Excess Water HP Throttled at Constant Speed	Assumed Station Efficiency	Hours Operation Per Year	Equivalent Kwhr Savings
440,000	0	20%	500	0
300,000	54	17%	5,500	37,700
200,000	51	13%	1,500	7,400
100,000	36	8%	500	1,000
TOTAL				46,100

Fig. 4. Below. Performance of a 3560-rpm constant-speed pump, as discussed in text example

Fig. 5. Right. Performance of variable-speed pump, based on assumed system head curve, as discussed in text example


TOTAL HEAD AT 3560 RPM
EFFICIENCY AT 3560 RPM
BRAKE HORSEPOWER AT 3560 RPM AND 316 F
TOTAL HEAD IN FEET
EFFICIENCY IN %
BHP
CAPACITY IN GPM



ATOMICS

A New Section added to POWER GENERATION to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

Engineering and Economic Aspects of Atomic Energy

These remarks on the engineering and economic aspects of atomic energy are of particular interest because they were made by one of the members of the U.S. Atomic Energy Commission, Sumner T. Pike, before the Engineers' Council of Houston, Texas early last summer. Coming from Commissioner Pike they represent the consensus of opinion of the members of the Commission with all their inside knowlelge of what is going on in the field of atomic development

By **SUMNER T. PIKE,** U. S. Atomic Energy Commision

THE ECONOMIC aspects of atomic energy so far as we can now predict seem to lie in two distinct fields; one is power, the other involves the use of the so-called radioactive isotopes.

The problem of net, useable power from nuclear reactors seems to divide itself pretty neatly into two parts. First, can such power be obtained at all? And, second, if the answer to the first question is "yes," how soon and how far can it be expected to enter into competition with other sources of power? The first question can be answered affirmatively with the qualification that there is a considerable time element involved. This can hardly be expected to be less than five years, and might be as long as ten or fifteen. We expect to get some power out of a reactor now under consideration at Brookhaven, Long Island, and we hope to get this power somewhere around the end of 1949. However, this reactor is not being built primarily for power production and our best guess at present is that it may produce about enough to operate about one-half of the auxiliary equipment such as pumps and blowers which are a necessary part of the reactor set-up.

Up to date, no one acquainted with the problem has any reasonable hope of getting power from a nuclear reactor in any other way than by first reducing the released energy to heat as in the case of conventional fuels.[1] It also seems obvious to most of those who have given study to the matter that for highest efficiency the heat will have to be of a considerably higher order than the levels we are accustomed to in conventional power production. Levels of 1800 to 2700 F seem to be about the range to shoot for.

What will we use for Material?

Even if we were merely dealing with the ordinary power plant, the question would immediately arise as to whether steel can stand up as a good structural material at these heat ranges. The answer would be in some doubt, but I think it turns to an unqualified "no" when you consider a third requirement which is not present in ordinary heat engines. The nuclear reaction or fission is carried forward from an uranium atom to the next by means of a fundamental particle called the neutron. If something intervenes to absorb the neutrons the chain is broken and the reaction stops. One of the essentials of a nuclear reactor, then, is that too many neutrons not be wasted either to the outside of the machine or through absorption in the reactor itself. Steel does not look suitable for this purpose. So we have on our hands a metallurgical problem. Success in building power reactors seems to call for a metal of good structural strength (equivalent to or better than steel) which will stand considerably higher temperatures than conventional steel, which in addition will not absorb too many neutrons, and thus slow down or stop the reaction. Furthermore, if possible, the structural material should be one which could eventually be produced at a reasonably low cost.

I am not certain just what direction the thinking is taking as to specific metals that can be used, and if I were certain, I probably could not discuss it here. But a glance at the Periodic Table of Elements and some rough knowledge of the plentifulness of the elements in nature, shows—to pick one—titanium as a possible candidate. Titanium has a strength-weight ratio considerably better than good structural steel. It seems to stand up under high temperatures very well indeed, and let us say for the sake of argument, although I don't know whether it is true or not, that it has a very low neutron absorption co-efficient. In addition, titanium is a very plentiful element. It happens not to have been used much except as a base for paint. As a pure metal, it hardly exists at all. It is in about the same

[1] See Nuclear Energy and Electric Power, By Andrew W. Kramer, Part I, Page 104, March, 1947, Part II, May, 1947.

state that aluminum was eighty or ninety years ago. If titanium turns out to have the qualities that we want, there is no immediately obvious reason why it can't be produced in large quantities and at quite low cost per pound.

In other words, this problem of the structural skeleton of the reactor looks like a difficult, time-consuming job, but one that is soluble on lines that are familiar to metallurgists and engineers.

What Kind of Heat Exchangers?

The next question that obviously hits us is what do we use for heat exchangers? How do we take heat from the reactor to the turbine which turns around and does useful work? It seems fairly clear that steam which we use in boiler plants is not going to be the answer. Steam at such high temperatures as will exist in reactors means very high pressures which means in turn very large amounts of metal in the tubes which will carry it through the reactor which again means that useful neutrons will be absorbed in undue quantities tending to dampen or stop the action of the pile.

Also, there is another requirement which does not enter in the ordinary steam boiler, namely, that the heat exchanger used shall not carry out into the plant itself any undue quantities of the radioactivity existing in the reactor, or if it does carry such radioactivity out of the reactor, it will not in turn retransmit it to a possible second set of heat exchangers which would have to be placed between the reactor and the turbine. These requirements again narrow the possibilities down to a few inert gases or some metals which are liquids at the temperatures we are talking about. And, in either case there are further questions of erosion, corrosion, problems of the design of special pumps and seals to prevent contamination either of the circulating medium or the atmosphere around the plant. This problem again is of an order which has been solved many times and which we can expect to be solved again.

There are other serious questions such as the reconditioning of fuel and disposal of radioactive waste products, and in adding them all up, we have to conclude that there are too many unknowns in the equation to expect a solution at the first try. What must be done it seems to me is to get several coordinated groups to attack the problem from somewhat different points of view, come down to two or three possible designs, each one concentrating on some particular problem or design feature, analyze carefully the contributions which each design has made and where it has failed and try again. Unless we are extraordinarily lucky on the first designs, a good operative nuclear reactor which will

Fig. 1. Model of nuclear power plant, one of several exhibits of the Brookhaven National Laboratory Atomic Energy exhibit

produce net useful power for any purpose will be achieved only through a series of successive approximations.

Perhaps I might illustrate what I mean by several points of attack. Most of the thinking in this area goes toward the high efficiency and high temperatures which I mentioned earlier. One of the groups however which has long practical experience in power plant design believes that considerably lower temperatures than the ones which I suggested can be used without serious loss of efficiency in the plant. If this turns out to be true, several of the problems while still formidable will almost surely be of a somewhat lower order of difficulty.

Economic Competition

Now, let us try to examine the second half of the question which is that of economic competition with other methods of producing power. I suppose it is a fair approximation to say that the cost of power from any source is made up of its capital cost, its operating cost and depreciation or obsolescence. Hydroelectric power, as we know, normally has a high capital cost, a very small operating cost, very small depreciation, and since a good hydroelectric plant operates close to top theoretical efficiency, almost no obsolescence. A steam plant—and now we are talking about the boiler end of the steam plant, since the nuclear reactor as power producer is merely the boiler end of the plant —the steam plant has characteristically a low capital cost, a high operating cost, largely for fuel consumption and a medium rate of depreciation or obsolescence which, since the initial capital cost is quite low, has little effect on the ultimate cost of power. When we get to the question of cost of power for atomic energy, we might as well admit at once that we are all at sea on each one of the major factors of cost. Until we have made a machine that will operate at all, we can't have any accurate idea of the capital cost. Any cost estimates based on the presently available scanty data would indicate that at the beginning the capital cost would be so high that even if there were no operating or depreciation factors, interest charges alone would take the atomic power plant out of competition with present methods of power production.

This, however, should not be taken very seriously because as soon as the first practical working prototype is in operation, then the matter of capital costs can and will be seriously attacked. If previous history is any indication, good research development and engineering skill will effect radical reductions. Operating costs will probably be high in the first instance. Only the future can tell about the cost of fuel. If exploration for large deposits of uranium is successful, which is a reasonable hope, operating costs for fuel can be pulled down into the practicable range. This is a question which only time and effort can solve and effort is being expended in search. Labor costs on nuclear reactors will tend to be high at first, but as we work from the experimental zone it should be lowered gradually.

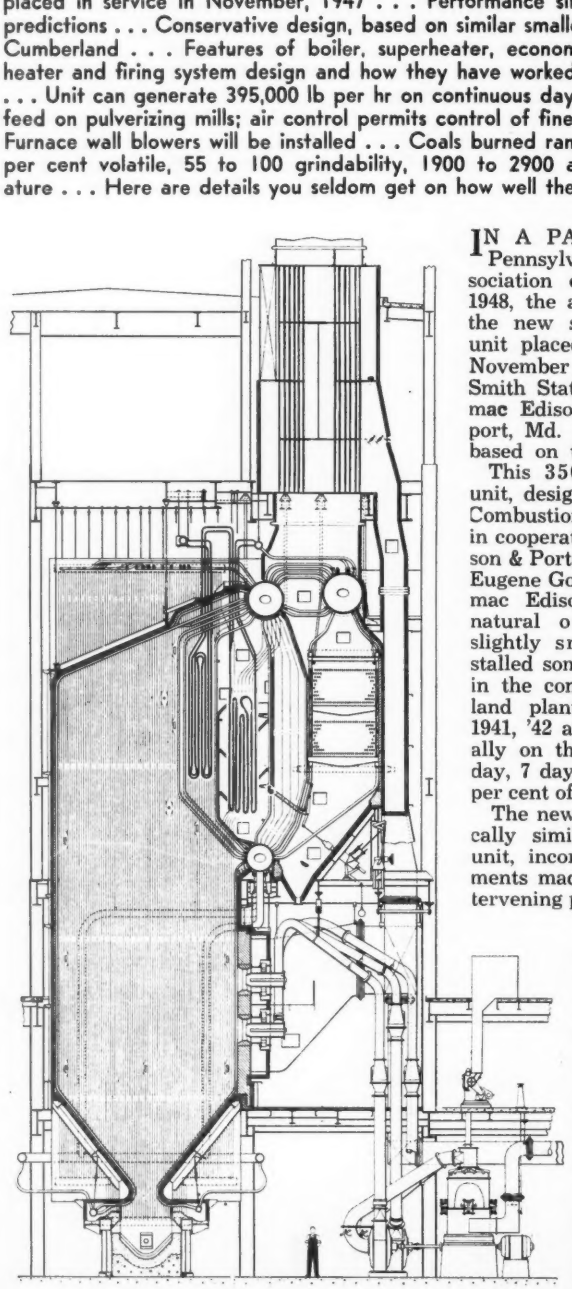
The heavy shielding required for protection against health hazards would seem to eliminate in the present state of knowledge any use of

(Continued on page 138)

How Williamsport Boiler Design Features Worked Out in Operation

By H. G. EBDON, General Sales Manager and A. T. HUNTER, Sales Engineer, Philadelphia District, Combustion Engineering Co.

At Paul V. Smith Station of Potomac Edison Co., at Williamsport, Md., this 350,000-lb-per-hr, 910-psi, 910-F pulverized-coal-fired steam generating unit placed in service in November, 1947 . . . Performance since then close to predictions . . . Conservative design, based on similar smaller unit of 1941 at Cumberland . . . Features of boiler, superheater, economizer, furnace, air heater and firing system design and how they have worked out in operation . . . Unit can generate 395,000 lb per hr on continuous day load . . . Center feed on pulverizing mills; air control permits control of fineness for load . . . Furnace wall blowers will be installed . . . Coals burned range from 18 to 37 per cent volatile, 55 to 100 grindability, 1900 to 2900 ash-fusion temperature . . . Here are details you seldom get on how well the design works out



General cross-section through 350,000-lb-per-hr, 910-psi, 910-F pulverized-coal-fired steam generating unit at Paul V. Smith Station, Williamsport, Md. Standard three-drum boiler, two-stage superheater, fin-tube economizer, completely water-cooled furnace, firing by six horizontal turbulent burners, supplied with pulverized coal by three bowl mills

IN A PAPER before the Pennsylvania Electric Association on February 19, 1948, the authors described the new steam generating unit placed in service last November at the Paul V. Smith Station of the Potomac Edison Co., Williamsport, Md. The following is based on that paper.

This 350,000-lb-per-hr unit, designed and built by Combustion Engineering Co. in cooperation with Sanderson & Porter, engineers, and Eugene Gordon of the Potomac Edison Co., was the natural outgrowth of a slightly smaller unit installed some nine years ago in the company's Cumberland plant, which, during 1941, '42 and '43, was actually on the line 24 hr per day, 7 days a week for 98.2 per cent of the entire period.

The new unit, while basically similar to the older unit, incorporates developments made during the intervening period and follows the general trend toward greater conservatism and more generous proportions.

Design Features of Williamsport Unit

It was anticipated when the design was set up that the maximum turbine throughput would be 330,000 lb of steam per hour, at 910 psi at the superheater outlet and 910 F total steam temperature. Accordingly, the unit was designed for a maximum continuous output of 350,000 lb per hr. However, since it was placed in service in November 1947, it has carried continuous day loads of 385,000 to 395,000 lb per hr with 42,000 kw load on the turbine. It is anticipated that this overload will be carried as long as the present urgent demands on the system continue.

The unit incorporates a standard three-drum boiler, a two-stage superheater, a fin-tube economizer, completely water-cooled furnace with hopper bottom, and a tubular air preheater. It is fired by six horizontal turbulent burners, supplied by three C. E. Raymond bowl mills.

The furnace water walls consist of 3-in. plain tubes on 3⅛-in. centers for the front and sides and fin tubes on 5⅛-in. centers on the rear wall and roof. There are no intermediate water wall headers. With a total furnace volume of 23,000 cu ft, the heat release at 350,000 lb per hr output is 20,000 Btu per cu ft per hr, and 22,500 Btu at 395,000 lb per hr output. This furnace design was predicated on a desire to permit the use of a wide range of coals and a minimum ash-fusion temperature of 2000 F. By contrast, the older unit mentioned had been designed for and operated with a heat release of 26,200 Btu per cu ft per hr.

Steam Temperature Control—Design and Performance

In line with the three-drum arrangement as widely employed in utility plants, there is incorporated a two-stage superheater with bypass damper control for steam temperature and a fin-tube economizer in the last pass. The vertical development of the unit with tubular air preheater, dust collector and fans at the top was dictated by space limitations and other considerations involved in this extension of the existing stoker-fired plant. The steam

Table showing actual operating data compared with predicted performance of Williamsport steam generating unit

	Actual Board Readings	Predicted
Load lb Steam per Hr.	350,000—360,000	350,000
Steam Pressure at Turbine	850 psi	
Steam Pressure at Superheater Outlet	885 psi	910 psi
Steam Temperature	900 F	900 F
Superheater Bypass Opening	0—30 deg	
Economizer Inlet Water Temp.	410—415 F	385 F
Economizer Outlet Water Temp.	500—505 F	502 F
Gas Temperature Leaving Boiler	895—1000 F	1045 F
Gas Temperature Leaving Economizer	605—640 F	638 F
Air to Air Preheater	100—120 F (Outdoor Air 80F)	80 F
Air from Air Heater	452—465 F	492 F
Gas from Air Heater	345—365 F	335 F
CO_2 at Boiler Outlet, %	14.5—15%	15%
Total Draft at Air Heater Outlet, In. WG	6.2"	7.7"
Total Air Pressure at Air Heater Inlet, In. WG	7.4"	7.6"
Solids in Steam Leaving Superheater (Conductivity Measurement)	0.5—0.7 ppm (Undegasified)	1 ppm

drums are 48- and 54-in. diameter, with primary steam separation in the front drum and a bubble-type steam washer and screen dryer in the other drum. Solids in the steam were guaranteed to be less than one part per million, but readings on undegasified samples have consistently shown 0.5 to 0.7 ppm by conductivity measurements.

The two-stage superheater is designed for the very low gas velocity of 33 ft per sec which is approximately a quarter of that of the earlier unit. This low velocity, in combination with wide tube spacing in the primary section of the superheater, insures against slag deposits. Standard low-carbon tubing was used for superheater elements up to 750 F; and from there to 900 F, total steam temperature alloy tubing was employed.

While the design provided for maintaining 900 F total steam temperature from 190,000 to 350,000 lb per hr output by means of the superheater bypass damper, this range of control was not only attained but extended up to the 395,000-lb load. The damper operates from 0 to 30 per cent open at 350,000 lb per hr output and 0 to 50 per cent at 395,000 lb. The bypass damper is motor-operated and has push-button control at the operating board. Automatic control could have been applied, but this was not considered necessary for the load conditions to be met. This damper is of high-nickel alloy (Fahrite) and is located in a zone where the gas temperature is approximately 1200 F.

The fin-tube Elesco economizer decreases the gas temperature from approximately 1000 F to around 630 F with an entering feedwater temperature at 385 F. It is interesting that operating experience has been such that routine soot blowing of the economizer has been discontinued, for the dust deposit has been so limited that the gas temperature variation has never exceeded five degrees, even after a month's operation without blowing.

To protect the air preheater from corrosion and plugging during low-load operation, it was arranged that one-half the surface could be cut out by means of the air damper shown and a gas damper above one bank of tubes. This increases the gas velocity and gas leaving temperature at low loads, and prevents the possibility of setting up dewpoint conditions.

Mill Selection and Operation

As previously mentioned, the unit is fired by six horizontal turbulent-type burners supplied by three bowl mills. In line with the desire to provide for use of the complete range of available coals, the mills were generously selected with a normal capacity of 12,300 lb per hr each when handling coal of 50 grindability and 10 per cent moisture, pulverizing to 80 per cent through a 200-mesh screen. This corresponds to the requirements for 350,000 lb per hr output with coal of 12,000 Btu as fired.

The mill characteristic is such that with coal of 100 grindability, mill capacity with the above-mentioned moisture and fineness would be 21,000 lb per hr. This has resulted in ability to carry the overload up to 395,000 lb per hr under practically all conditions of coal as normally received, although there have been times when the heating value of the coal was as low as 9,000 Btu per lb with 10 per cent moisture and 50 to 55 grindability. At such times, the boiler capacity was limited to 370,000 lb per hr.

In the early stages of operation, when putting the unit "through its paces," loads up to 200,000 lb per hr were carried on one mill and two burners with 80 grindability coal and 300,000 lb per hr with two mills and four burners.

Load characteristics are such that, starting at 7 a.m. with 70,000 to 90,000 lb per hr, demand comes on the turbine fast enough to increase the steam output of the boiler to 395,000 lb per hr in ½ hr. Normal procedure is to carry the load on one mill up to 190,000 lb, then put the second mill in service up to 280,000 lb per hr steam demand, from which point upward the third mill is put in service.

An interesting feature of this mill installation is the center feed, in which the coal is dropped directly into the center of the bowl, with preheated air under control admitted between the feeder and the mill. Control of air permits control of fineness to suit the load, from the standpoint of stability and performance.

A feature of the burner design is incorporation of carborundum throat tile as a means for eliminating ash build-up at this point. It has proved completely effective.

Because of the conservative design of the unit, for the maximum rated output of 350,000 lb per hr, it was not considered necessary to incorporate furnace wall blowers in the initial design. However, experience with continuous overloads up to 395,000 lb per hr when burning very low ash-fusion coals indicated the desirability of employing such blowers. Therefore, it is planned to install them during the first scheduled outage.

Performance Close to Predictions

Actual performance has been very close to that predicted. The unit is understood to be showing a monthly efficiency of 85 per cent, based on scale weight of coal and steam flow meter reading, including daytime operation at 385,000 to 395,000 lb of steam per hour and a night load of 70,000 to 100,000 lb; whereas the predicted efficiency at rated load of 350,000 lb per hr was 86.4 per cent.

The heat balance on which guaranteed efficiency was set up included a predicted carbon loss of 1.2 per cent at 350,000 lb per hr. However, dust samples taken to determine carbon loss at 390,000 lb per hr showed less than one-half that predicted.

Coals being burned range from 18 to 37 per cent volatile, 55 to 100 grindability, 1900 to 2900 F ash-fusion temperature. These characteristics sometimes change from hour to hour as the coal feeds from the bunker, and the operators have no advance notice of such changes. In view of this, it has been desirable to operate with somewhat higher excess air than would otherwise be employed; that is, around 14.5 per cent CO_2 is being carried at the boiler outlet.

The PRACTICAL ENGINEER

DEVOTED TO PLANT OPERATION and MAINTENANCE

A. W. KRAMER, EDITOR

More on Handling Frozen Coal

As this is published, the temperature may be hovering around 95 F in the shade—and no shade—and you will be wondering why you have to worry about frozen coal . . . But you will have to worry about it in a relatively short time . . . And now is the time to begin planning what you are going to do next winter when the troubles start with handling frozen coal . . . These troubles vary all the way from mere annoyances to labor-consuming and plant-delaying problems of major importance, depending on the weather and the time taken in transit

EVEN THOUGH the problem of handling frozen coal seems fundamentally simple, there is no standard or generally accepted solution for it. It is commonly looked upon as a seasonal nuisance and handled each time as an emergency, dealt with by improvised measures, usually meaning the inefficient application of manual labor.

Permanent installations of effective mechanical equipment to handle frozen coal shipments have been made only where rigorous climatic conditions persist over long periods, or where large volumes of material are to be handled. However, a substantial number of these installations, in the aggregate, make up a special technology that might be much more widely applied.

Several precautionary and preventive measures may be taken at the mines, for, in the broader sense, the problem of frozen coal is the common concern of producers, haulers and users alike. Preventive treatment is applied in widely varying measure in the mining fields, depending mainly upon the market areas into which the product goes and the severity of the climate.

A number of these preventive treatments and some of the mechanical equipment available for solving the problem were discussed in a recent article in *Utilization*.

Preventive Treatment

Frozen coal shipments result, of course, from freezing of water in the inter-particle spaces to cement the coal together in a solid mass. Hence the initial underlying factor is the presence of free surface water in the coal in the car. Obviously the most direct preventive measure is to ship the coal dry; but this is by no means a simple remedy. Most of the cleaning plants for removing ash-forming impurities from the coal use water in the process. This is considered to be the chief cause of freezing trouble, but it is by no means impossible to have frozen shipments of unwashed coal. The coal may be wet when mined, or it may be drenched with snow or rain during movement of cars.

Drying of coal before shipment is one of the measures sometimes practiced. It is generally considered that good draining screens of ample area will eliminate free water from well-screened, washed prepared, sizes sufficiently to prevent freezing, since water runs freely from coal that is free of fines.

Smaller-size grades retain more surface water. Screenings and slacks may be prepared so as to be fairly free from serious freezing trouble in moderate winter weather by centrifugal dewaterizing, but thermal drying is more effective. Even with complete thermal drying, shipments in open-top cars are vulnerable to the weather.

Slack, ⅜ in. x 0, is generally considered to be safe from freezing if surface moisture is less than 5 per cent before shipment and if there is no rain on the coal in transit. With favorable operating conditions, washed coal can be dewatered to about that limit in centrifuges. However, conditions vary so widely that it is unsafe to set up a definite specification for moisture content that will assure freedom from freezing. The hazard depends upon temperature during shipment, length of time the coal is subjected to low temperatures, the size consist, and the distribution of water through the coal in the cars, as well as the average moisture content.

By far the most widely used method of freeze prevention is treatment of the coal by adding some reagent to prevent freezing or to definitely lower the freezing point of the water.

Freezeproofing Treatments

There are two types of treating reagents: (1) oils and oily substances which make the coal surfaces resistant to wetting and mechanically deter cementing of the coal particles by freezing of interstitial water, and (2) water soluble salts that reduce the freezing temperature of the water in some ratio to concentration of the salt in solution.

Treatment with these reagents is specifically referred to as "freeze-proofing." Some of these same materials are adapted to the purpose of "dustproofing" the coal, a practice that is popular particularly for treatment of domestic coal. Hence, it is feasible in some instances to combine these two services, "freeze-proofing" and "dustproofing," in one operation, or to use one plant installation to apply either treatment.

All these treating agents are applied in small quantities, but the requirement varies somewhat with the texture and size consist of the coal. Oil treatment of stoker coal and nut-slack grades requires 3 to 12 gal per ton. This will prevent freezing in moderately cold weather.

In treatment primarily for freeze-proofing, the salts have the advantage that any given concentration of a salt has a definite freezing point,

Table I.—Recommended Quantities of Rock Salt or Calcium Chloride for Freezeproofing Coal Shipments

Temperature F	(Lb per ton of coal treated) Surface moisture, per cent 3	6	9
20	3.4	6.8	10.2
10	5.0	10.6	15.0
0	6.6	13.2	19.8
—10	8.2	16.4	24.6
—20	9.2	18.4	27.6

hence any anticipated weather condition may be provided against. However, the treatment may be partly nullified by dilution with rain or snow, or the salt may be carried away by draining out with initial water in transit. Cheap halogen salts, most commonly used for freezeproofing treatment, are commercial calcium chloride or calcium magnesium chlorides and rock salt. There are also several very suitable proprietary treatment reagents in which the base salt is modified with other elements, to improve its effectiveness for special conditions and to mitigate the corrosive effect on equipment.

Methods of Applying Salt Treatments

Bituminous Coal Research, Inc. has recommended the schedule of treatment rates shown in Table I, based on observations made during extensive investigations of the effectiveness of these measures.

The salts are mixed with the coal while it is being loaded into railway cars for shipment. For dustproofing it is sprayed uniformly on the coal in a concentrated solution, but when the primary object is freezeproofing it is considered better to add dry salt to the coal to avoid adding more water and to retard solution and partial loss of the salt by drainage of water from the coal after loading.

For most effective application to prevent freezing, the salt may be concentrated in the coal near the sides of the car and in the bottom, where it is first subjected to penetration of cold. This practice adds to the cost of treatment, for this extra-heavy treatment in certain parts of the car must be done by hand, whereas mechanical means can be provided to add the salt uniformly to the coal.

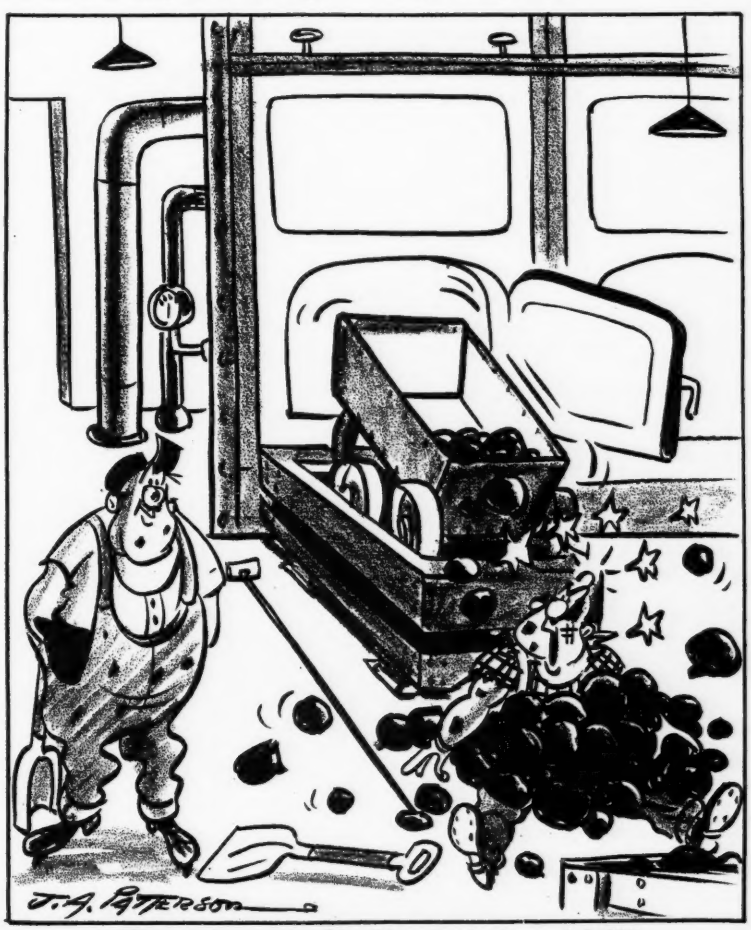
Some shippers treat the coal very heavily just above the hoppers to make sure that the unloading will at least start. Release of the coal immediately above the doors then makes a free space to break into with bars, by hand operations, to help the discharge of the remainder of the load. Freezeproofing treatment of the coal before shipment is generally found to be helpful in unloading and handling even though freezing is not entirely prevented.

In severe weather, which would require very heavy and costly treatment to prevent freezing, it is probably more economical to treat the shipment moderately at the mines and then apply some mechanical aid to unloading at the destination. The loosely-cemented partially frozen coal can be usually discharged with moderate barring and shoveling.

Table II. Equipment Reference

Preventive Treatment:	
Soluble Salts, Oils and Compounds:	
Compound M, Coaladd, Oiladd	Johnson-March Corp.
Calcium Chloride	The Dow Chemical Co. Wyandotte Chemicals Corp. Solvay Sales Corp. Pittsburgh Plate Glass Co.
Sealite	Midland Sealite Corp.
Coal Spray Oils	Standard Oil Co. of N. J. Texas Co.
Oil Spray Equipment	Viking Mfg. Co. Brown-Fayro Co.
Unloading Equipment:	
Heat Methods:	
Thawing Pits	Hauck Mfg. Co.
Coal De-Icer	J. C. Corrigan Co.
Mechanical Methods	
Displacer	Link-Belt Co.
Coal Shear	Silent Hoist Crane Co.
Car Shake-Out	Robins Conveyor Div. of Hewitt-Robins, Inc.
Material Accelerator	Stephens Adamson Mfg. Co.

Two general methods of forcing the discharge of frozen coal from the cars at the unloading point are: (1) by applying heat; (2) by mechanical agitation. A combination of the two is commonly used.



"You sure we got this thing hooked up right??"

Where freezing weather is experienced only infrequently, it is customary to unload frozen coal by emergency makeshift methods, especially at small plants, and where moderate delays in delivery of coal do not seriously interrupt production operations.

In such an emergency, the first move usually is to apply heat around the hopper doors with hand-held torches and to hammer on the sides of the cars with heavy sledges—bars and shovels are used to break up the frozen coal inside the car. In extreme conditions, the use of explosives has sometimes been necessary. These methods are hard on transportation equipment and are, of course, very expensive because of the inefficient use of manual labor. Where difficulty is encountered regularly, more effective means of unloading coal should be planned.

Application of Heat

Many kinds of stoves and oil-burners have been devised to apply heat under the cars before they are unloaded. V-shaped troughs of burning fuel oil, placed under the cars at the hopper gates, apply heat at the most essential point to start discharge of the coal. Makeshift devices for applying flame directly to the car body are destructive and costly.

Permanent thawing plants for systematic application of heat to prepare frozen cars for unloading consist of thawing sheds, thawing pits and other arrangements in which heat is applied indirectly without any flame impinging upon the car surfaces.

The most complete and effective job of thawing coal to prepare it for unloading is done with thawing sheds. This requires a large capital outlay for permanent equipment, but it provides a permanent and dependable solution of the problem which justifies the investment where coal shipments are handled on a large scale in latitudes where long severe winters are a regular thing. This type of unloading plant is used by large coal users and forwarders of coal and ore, particularly in the Upper Great Lakes region.

Thawing pits installed under the tracks in storage yards at the unloading point furnish a less costly but still effective means of preparatory thawing. Details of these were given in these columns in the article Radiant Heat Thaws Frozen Coal Cars, March 1946, POWER PLANT ENGINEERING.

Mechanical Unloading Methods

Among the power driven mechanized aids to unloading are heavy slicing and poking devices that may be lowered into the car from above and vibrating devices that may be attached to the car body to shake out the contents.

One device is known as the coal shear. Another device widely used to speed up on unloading of frozen coals is the car shake-out. A third is the material accelerator. These were described and discussed in the article New Ideas in Power Plant Coal Handling by Wilbur G. Hudson, POWER PLANT ENGINEERING, June 1947. A detailed description of the accelerator was given in the article Unloading Fine Wet Coal With the Material Accelerator, October 1944.

PRACTICAL ENGINEER SECTION

Long Steam Supply and Return Mains

LONG RUNS of new steam supply and return mains at the U. S. Department of Agriculture's Research Center, covering 12,000 acres near Beltsville, Maryland, are placed in concrete tunnels that are covered by concrete slabs. These lines run from the institution's steam plant to Zoology buildings, and consist of 2½-in. and 1½-in. supply pipes and 1-in. returns. Both the soil conditions and boiler feedwater are extremely corrosive, it was reported, and wrought iron piping is used throughout the system. Welding was used for all joints. About 2000 ft of 6-in. wrought iron pipe will be installed at a later date between the steam plant and buildings in the animal husbandry section.

QUICK-STARTING HOUSE TURBINE-GENERATOR FOR COAST UTILITY

A 6000-KW GENERAL ELECTRIC house turbine-generator unit designed for quick starting and capable of picking up full load instantly has been installed at the Pacific Gas and Electric Co. Kern Steam Plant near Bakersfield, California.

The quick-starting unit ordered by the West Coast utility was manufactured at the company's Lynn (River Works), Mass., plant. Additional units for the Kern plant and for the Station "P" Steam Plant in San Francisco are in process of manufacture. They are rated at 7500-kw.

Under normal operation, the turbine floats on the line, carrying load in accordance with the steam demand of the deaerating heater of the main unit and exhausts through a five pound extraction opening.

In case of a disturbance in the electrical system, the house turbine generator is automatically isolated from the main bus and picks up the entire station auxiliary load instantly.

The 6000-kw G-E turbine-generator is capable of going from a cold standstill to full speed load within 20 seconds with steam 1350 psig and 950 F total temperature. Extensive factory tests of the complete unit proved its capabilities for the unusual service for which it was designed.

Although designed for quick-starting, the unit is expected to be in operation pratically all the time.

New Curtis Power Plant at Sharon Hill Burns Anthracite

Supplies steam to new printing plant of Curtis Publishing Co. at Sharon Hill, Pa.; electric power purchased . . . Two steam generating units, burning anthracite on traveling grate stokers, each capable of generating 65,000 lb of steam per hour continuously at 200 psi, 388 F . . . Details of coal-handling, feedwater supply, draft equipment

THE PLANT consists of two 2-drum type, water-tube steam generators with a maximum continuous steam generating capacity of 65,000 lbs per hr, at a pressure at 200 psig and 388 F with feedwater at approximately 212 F. The designed pressure of the boilers is 250 psig. The boilers are also capable of operation at a maximum continuous steam generating rate of 75,000 lb per hr for 4 hours, other conditions remaining the same. The fuel will be Pennsylvania No. 3 buckwheat anthracite burned on traveling grate stokers.

The auxiliaries consist of over-fire air fan, forced and induced draft fans, soot blowers and soot hoppers, cinder recovery system, boiler feed pumps, coal handling equipment, pneumatic ash-conveying equipment, deaerating heater, and condensate receiver and pumps.

The stoker is of the traveling grate type suitable for burning the Pennsylvania No. 3 buckwheat anthracite, and complete with constant-speed motor and drive units, screw conveyor system for siftings removal, standard coal hopper, adjustable coal-regulating gate, air supply compartments with suitable dampers externally controlled, and necessary observation and access doors. The drive mechanism of each stoker consists of a constant-speed turbine, with a variable speed unit, transmission gears, and a worm-and-gear arrangement for driving the rear stoker drive shaft.

Overfire air is furnished by a motor-driven fan and duct system with nozzles inserted through the rear stoker arch.

There is one forced draft fan for each steam generating unit, driven by a 40-hp, 440-v, 3-phase, 60-cycle squirrel-cage induction motor. There is also one induced draft fan for each steam generating unit, connected to be driven either by a 60-hp, 3-phase, 60-cycle induction motor or by a steam turbine when an emergency arises.

Soot blowing equipment has been provided for keeping the gas passages of the boiler clean by use of saturated steam at 200 psig.

Cinder recovery system for each steam generating unit collects cinders from the soot hoppers located behind the lower boiler drum and reinjects the cinders through the rear stoker wall on to the traveling grate of the stoker. The system is actuated by a blower driven by a 2-hp, 440-v, 3-phase, 60-cycle squirrel-cage induction motor.

For the two steam generating units there are three boiler feed pumps, one being driven by a steam turbine, and two by electric motor, a 100-hp, 440-v, 3-phase, 60-cycle squirrel-cage induction motor on each. Capacity of each pump is 130,000 lbs of water per hour.

Exterior view of power plant supplying service to new Curtis Publishing Co. plant at Sharon Hill, Pa.

By means of a system of hoppers, apron feeders, vertical elevator, cross conveyor, weightometer, and distributing conveyor, the coal is loaded into the bunkers, from which it is fed by gravity down to the stokers at the rate of approximately 10,000 lbs of coal per hour for each steam generating unit.

The ash-conveying system draws ash from the boiler ash pits and cinder-catcher hoppers and delivers the ash to an overhead ash-storage tank, from which the ash is taken by truck. The vacuum is provided by steam jet vacuum-producing equipment suitable for operation with steam at 175 psig saturated. Automatic timing devices are electrically operated.

Water is furnished to the boilers through a deaerating heater, which receives condensate returns at temperatures varying from 100 to 200 F and treated make-up water, which is delivered to the regulating valves of the heater at temperatures ranging from 35 to 90 F and pressures from 40 to 50 psig. Steam is supplied at 6 psig and saturated temperature. The unit has the capacity to heat water to the saturation temperature of the incoming steam and to remove all the oxygen from the effluent when delivering 250,000 lb per hr of water.

Condensate pump and receiver set delivers to the deaerating heater all condensate from the power plant heating system. The set is of the duplex pump and receiver type, with a rated capacity of 10,000 sq ft equivalent direct radiation against a discharge pressure of 40 psi. The two pumps are each driven by a 1-hp, 440-v, 3-phase, 60-cycle motor, and each has a capacity of 15 gpm against a discharge head of 40 psi. The receiver has a capacity of 30 gal.

A. G. CHRISTIE RETIRES FROM TEACHING

DOCTOR ALEXANDER G. CHRISTIE, who has been Professor of Mechanical Engineering at The Johns Hopkins University, Baltimore, Md., for the past 34 years, has been retired at the age limit. He will remain in Baltimore and devote more time to his consulting practice here and abroad in the power plant and industrial fields.

A few weeks ago he was awarded the Lamme Gold Medal by the American Society of Engineering Education for achievement in engineering teaching.

For many years, Dr. Christie has been active in the work of both ASME and ASEE; and his achievements both as an engineer and as a teacher of engineering have made him well known to all power engineers. He was president of the ASME in 1939, has held many other offices in the Society and is a member of many of its important technical committees.

The Water Column as a Safety Device

PRACTICAL ENGINEER SECTION

Water column should be thoroughly understood by power plant operating engineers . . . One of the most necessary and important safety devices on boiler . . . Type and size of piping connections and valves . . . Height of column should suit type of boiler . . . Details of installations on various types of boilers . . . Does water gage always show true level in boiler?

By C. C. CUSTER

"TO SHOW the level of the water, every power boiler should have at least one water column, which in turn should be equipped with a gage glass and three try cooks. The water column should be so located that when the water is at the lowest point of vision in the gage glass, the water in the boiler is at least 2 in. above all surfaces exposed to flame or hot gases. There should preferably be no valves between the boiler and water column; but, if local conditions make it advisable to place valves, they should be of the straight-way rising-stem outside-screw-and-yoke type of gate valve and locked or sealed in the open position."

The above is a definition from safe-practice pamphlets, but may be further explained. Water columns on hrt boilers are generally set to register 3 in. of water on top of the tubes when water appears in the glass. In marine boilers, it is 4 in. for another inch is allowed for the roll of the ship. For other makes of boilers, the lowest permissible level of water may be noted in Section A-21 in the ASME Code appendix. This section of the Code deals with the proper location of the fusible plug in various makes of boilers; thus the water column should be set so that, when the water shows up in the glass, there will be at least 2 in. of water over the fusible plug.

Least size of pipe to be used for piping water columns is defined by the Code as being 1 in. One state, Indiana, requires 1¼-in. pipe on 54-in. and larger diameter boilers. The connection to water glass should be ½-in. and the blow down from water column to ash-pit should be ¾-in. There should also be a ½-in. blowdown from the bottom of the water glass. A small pet-cock should not be used here as the blowdown from the glass, for it either invariably leaks or is found frozen fast, and leads to disuse of the blowdown.

On account of occasional corrosion inside the water connections to water columns, several state codes once required that brass pipe be used to the bottom connection of column. The Code says, however, that brass or copper pipe should not be used for pressures above 250 psi and temperatures above 406 F. In inspecting brass piping, one inspector found cases where the pipe used was not of correct thickness, being the thin pipe ordinarily used by plumbers. Brass pipe seems to be little used at present, for the hazard of internal corrosion is not so very serious. For the stem connection to the column, there is no objection to the use of steel pipe. Piping should preferably slope slightly downward toward the water column and from the bottom of the column should slope downward to the boiler without traps in either line. A trap in either line will lead to erroneous water level readings.

Valves in Column Piping

The objection to valves in the piping to the column is that a very serious condition arises if one forgets to open one of the valves; whether it be the top valve or the bottom valve, the result is the same—the water in the glass shows too high and may result in the fireman's getting low water.

The 1946 Code allows the installation of automatic cut-off valves in the connections to water glasses, but they must be of the approved type as described in A-18 of the appendix to the Code. As previously designed, some of these automatic cut-offs were a definite hazard. There was a type that was condemned by inspectors; this type operates somewhat like the ordinary cut-off used on an ammonia receiver. If, in the absence of the fireman, the water glass should crack near the top packing nut, these automatic checks are liable to close and the glass remain partially full of water. If the fireman does not discover it at once, he may shortly have low water. The moral is this:—Some of these automatic devices may become a hazard if their shortcomings are not thoroughly understood. Most engineers will be satisfied with the usual and dependable water glass

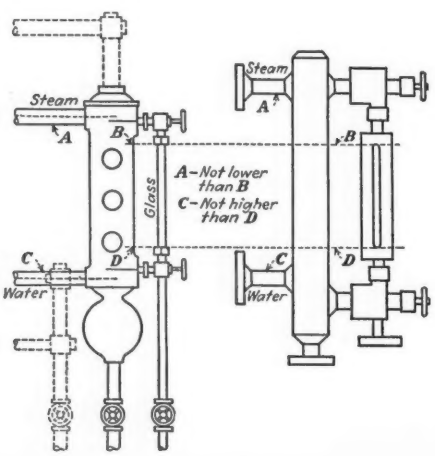


Fig. 1. Typical arrangement of steam and water connections for a water column

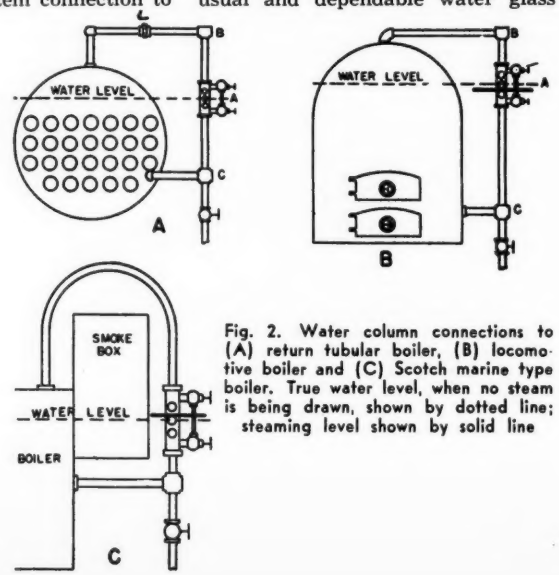


Fig. 2. Water column connections to (A) return tubular boiler, (B) locomotive boiler and (C) Scotch marine type boiler. True water level, when no steam is being drawn, shown by dotted line; steaming level shown by solid line

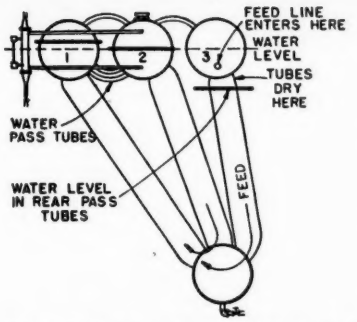


Fig. 3. Dotted line shows probable level in drums of 4-drum bent-tube boiler when no steam is being drawn. Solid lines show probable levels when boiler is steaming at rated capacity

cut-offs that are operated by a chain from the floor.

There has been quite a bit of controversy over whether the low-water alarm is a desirable adjunct to a water column. The arguments against it are that the fireman gets to depending on the alarm, instead of blowing down and using visual tests and is liable to be caught napping if anything goes wrong with the alarm. Whenever I find one of these installed, I ask the fireman how he likes this device? He generally says, "Just fine;—it never gives me any trouble." I always say, "In case you have a low water alarm, it does not relieve you of the duty of blowing down the column and testing the alarm as well."

One way of telling when the water column is functioning properly is by noting the movement of the water in the glass; if the boiler is steaming there ought to be a slight surging of the water up and down in the glass. If this surge is lacking, it may mean that the piping to the column is partially stopped up and needs investigation.

In marine practice, where it is customary to have stop-valves in the piping to the column, they have a test they call "alternate blowing down." You first close the top valve and blow the column down through the lower connection and then reverse and close bottom valve and blow out through the steam line at the top. Thus you are sure the piping is free.

Where the lower water connection has a right-angle bend, it should be fitted with a cross instead of an ell or tee, preferably with brass clean-out plugs. If the boiler is throwing down much scale, these plugs will need occasionally to be removed for inspection and cleaning. If cast-iron plugs are used, they often freeze fast and may be hard to remove.

The gage glass should be kept clean both inside and outside at all times, being removed for cleaning whenever necessary. The glass should never be allowed to leak, for the action of the steam rapidly grooves out the glass. When found grooved, the glass should be replaced by a new one.

Plumbers sometimes use lamp-wicking or asbestos wicking for packing gage glasses; this is never satisfactory. The rubber rings that are made for that purpose should be used and the gland, if taken up while hot, will produce a job that will stay tight. In most cases, where there is unusual breakage of gage glasses, it will generally be found that either the glass is of poor quality or that the top and bottom connections do not line up properly thus putting a strain on the glass. The glass should be resting only on the rubber and, for best results, should not touch the metal fittings, top or bottom.

For pressures and temperatures of steam above 225 psi, it is found that steam has a corroding and grooving effect on glass and a type of high-pressure water column is recommended in which sheets of heavy plate glass are the reflecting medium and they are protected on the water side of the case that holds them by a thin sheet of mica, so that no water or steam touches the glass at all. This type may be found in all high-pressure boilers.

When unions are used in water-column piping, they should be of the substantial flange union type and not lip-unions as sometimes found.

Most of the preceding remarks apply to medium-pressure jobs. It must be borne in mind that the water column and its fittings must be designed to fit the pressure at which it is to be used. For extra-high pressures, heavier fittings with further refinements should be used.

Column Should Fit Boiler

Another item to be remembered is that the height of a water column should be selected to suit the type of boiler on which it is to be installed. With boilers that have a limited steam space like the so-called Economic type of horizontal fire box boiler, the column must be necessarily shorter, with try cocks closer together, while on a boiler with much higher steam space, the column may be much higher with greater distance between the cocks. It is presumable, in each case, that the water should be carried not lower than the first try cock and not higher than the third gage.

Show me the engineer who habitually carries his water too high and I can predict that he is going to have wet steam and also safety-valve trouble. I once saw an engineer who was installing a second-hand boiler pick out an old water column from a scrap heap and install it. After the job was done, I showed him that although the bottom of the column was set to indicate the proper amount of water on the flues, if he were to fill to the top of the glass he would have the boiler entirely full of water up to the steam nozzle. In other words, the height of the column did not fit the boiler.

In piping to a water column, one should see that the pipes are not cramped where they pass through the brick work. Sometimes the setting settles a little and puts a strain on the pipes. One way to prevent this is to build a small tile lined with asbestos or mineral wool, into the wall to accommodate the pipe.

When Is Water Level?

When we speak of water level in a boiler it must be explained that the water is level only when the boiler is delivering no steam. When steaming, the natural result is to have the water highest where the most steam is being disengaged. One can see this by noting how the water boils in an open kettle over the fire. Nor can the water column be depended on to show the true level in all possible cases. Although the true level may not be widely variant, the engineer should understand these conditions that sometimes prevail.

Figure 2-A shows a hrt boiler having the piping to the water column laid out so that the vertical distance AB of the piping above the gage glass (AB) is approximately equal to that below the glass, AC. In this case, the true level of the water in the boiler will be approximately indicated in the gage glass. If, however the lip union L shown in the top connection springs a leak, a suction will be produced at the top of the column and the gage may show an inch or more of water than is actually in the boiler. Note that, according to the Code, unions in piping to columns should be of the more substantial type of flange unions instead of lip unions.

In figure 2-C is shown how the piping to a Scotch marine boiler water column is often arranged on the boiler room side. This boiler also has a second water column on

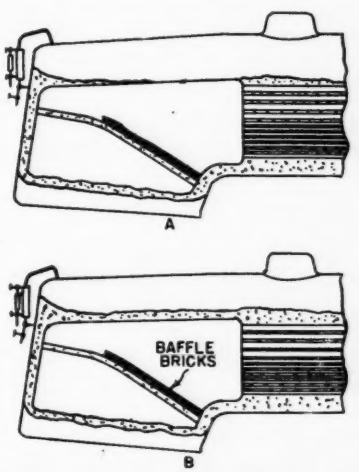


Fig. 4. How water level indications are affected by steaming characteristics in a locomotive boiler

the engine-room side, which is piped slightly different, more like sketch A. When in operation, the Type C column will often show an inch more water in the glass than the type A, but when both columns are given a good blowing down, they register nearly the same. It seems when there is an unusual length of steam line going to the column it causes that column to show the highest water level. Note that in the case of Figure 2-B, the fact that the distance AC is the greatest, means that water in that part becomes colder, on account of little circulation, thus the level in glass is a little lower. After a good blowing down it will often return about an inch higher in the glass.

In Fig. 4 is shown a rather serious condition which arises sometimes in the firebox of a locomotive boiler. On account of the upward thrust of the steam at front of firebox, maybe half a glass of water will show in the gage but there may be none on the rear of the crown sheet; in order to be sure you have water on the crown sheet it may be necessary to carry almost a full gage glass in order to know the crown sheet is fully protected.

Another extreme case is shown in regard to the 4-drum bent-tube boiler of Fig. 3. On account of the normal circulation of the boiler when steaming heavily, the water glass may show half a glass of water in the front drum while the water at rear is slightly below the rear drum, leaving the top ends of the tubes dry here. This would be more serious were it not for the fact that, being the third flame pass, the flames are not so hot here. However, it does make a vulnerable point in the boiler, as these tube ends where they stick up into the drum often develop fire cracks on account of the feedwater entering this drum striking the hot tube ends. These tubs ends need constant inspection as to their condition.

In Fig. 2 is shown typical arrangement of steam and water column connections for a water column. Note that the Code advises in the piping a cross or fitting, with a back outlet at each right angle turn, to permit inspection and cleaning in both directions.

BORN TOO LATE
or
STANLEY AND THE HOLE

By W. E. PATTEN

LIKE THE JINNI from Alladin's lamp, Stanley appeared in the shop bearing a piece of $\frac{3}{16}$ in. steel plate in which he had drilled a hole ¾ in. in diameter before he discovered that the job required the hole to be made larger.

Not having a larger drill or hole saw, he wanted the opening burned larger with the cutting torch. But luck has a habit of going into reverse at some time like this, and we then discovered that the last oxygen cylinder was empty because Joe had failed to turn off the tank valve and it happened to be a stem-leaker.

As the next best substitute, we handed Stanley a ratchet pipe reamer, pointed to the vise, and dropped a hint that a few minutes and a little muscle would cope with the situation nicely. Then we left to answer an SOS from another building.

The following day, by one of those rare chances, Stanley crossed our path again on his way back from another department two blocks away, carrying the same blasted piece of steel, with the hole perfectly burned up to size needed.

The head had not saved the heels in this case, but it had saved the arm muscles. The guy had walked four blocks and taken up another man's time to get that hole enlarged with a torch because he was too downright lazy to push a ratchet reamer for five minutes!

Old-timers are always deploring that the present generation is going to hell; but today's labor-saving machinery is helping them down to the Devil's boiler room faster than ever.

Repair work frequently consists of a multiple of unit operations, as contrasted to production work, which depends on repetition of the same operation. Power tools are invaluable on production jobs, but too many three-week wonders overlook the fact that hand tools are often faster where one or two operations are involved in completing the job.

Nobody would want to see a man swing a sledge for hours on a bull point breaking concrete, when an air hammer would do the same work in one-tenth the time. But when a man spends half an hour locating and trailing out a hundred feet of extension cord to use an electric drill to drill one hole, he is suffering from the fact that he was born too late—too late to know how good a breast drill or hand brace really can work with a properly sharpened twist drill or auger bit on the leading end and a little muscle power behind it.

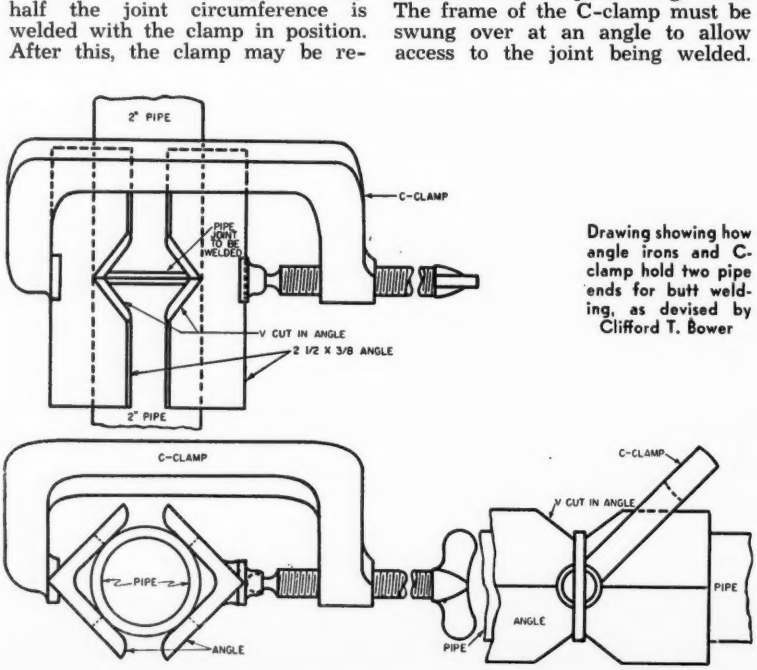
PRACTICAL ENGINEER SECTION

MODIFIED C-CLAMP HOLDS PIPE FOR WELDING

By CLIFFORD T. BOWER

MAINTENANCE of alignment when butt-welding 2-in pipe joints proved troublesome until a clamp was built up from a standard 6-in C-clamp and two pieces of rolled steel angle. The clamp enables two pipe ends to be held in line while approximately half the joint circumference is welded with the clamp in position. After this, the clamp may be removed and the remainder of the joint filled in with welding rod.

The angle iron used for the clamp is 2½ in. by ⅜ in. and each piece is 6 in. long. After sawing out the V's in each clamp plate, the jaws of the C-clamp are nicked across their faces to locate the pieces of angle. When welding the clamp pieces to the C-clamp jaws, a length of pipe or rod should be placed between them and the clamp screw tightened. The frame of the C-clamp must be swung over at an angle to allow access to the joint being welded.



Drawing showing how angle irons and C-clamp hold two pipe ends for butt welding, as devised by Clifford T. Bower

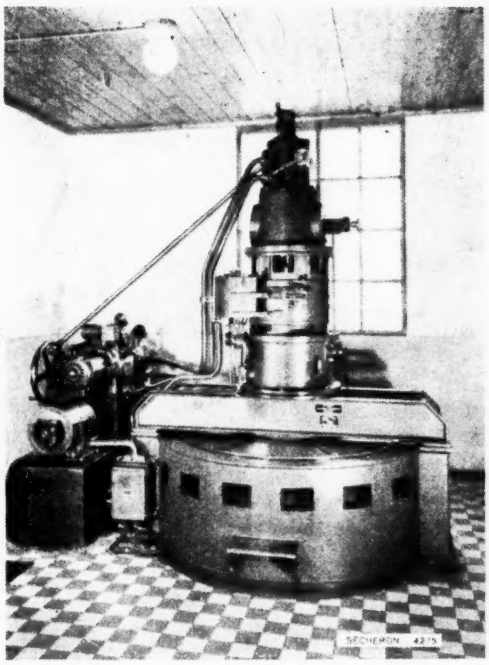


Fig. 1. Power station at Vessy, owned by the Societe des Eaux de l'Arve Geneve. Three-phase generator of 54 kva at 380/220 volts, 300 rpm

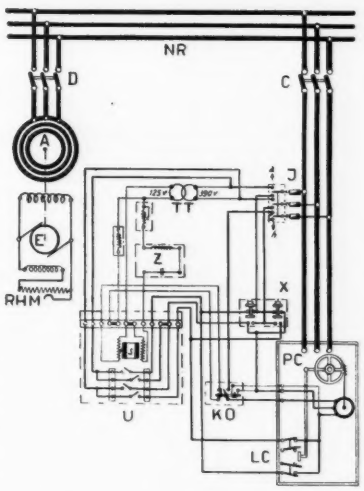


Fig. 3. Right. Diagrammatic illustration of an automatic frequency regulator as effected in the plant at the Scolari Works at Derendingen. A=Generator, E=Exciter, D=Circuit-breaker, NR=Regulated network, C=Switch, TT=Voltage transformer, J=Commutator, S=Measuring system, Z=Impedance, X=Push buttons, U=Commutator, LC=Limit switch, KO=Control relay, RHM=Hand-controlled exciter rheostat, PC=Electric boiler

Small Industrial Electric Power Stations in Switzerland

FOR SOME YEARS, industrial firms of some importance in Switzerland have endeavored to meet their requirements for electric energy by means of their own power plants. This tendency may also be considered as advantageous for the supply companies, who can, shou'd necessity arise, relieve their power installations by absorbing any excess energy produced by these small power stations, which are in fact generally connected to the supply mains. *Swiss Technics* describes briefly some installations supplied by the Secheron Works, Geneva, not only in Switzerland but also to other countries. First is a low-power plant: that in the power station of the Societe des Eaux de l'Arve, at Geneva. The 54-kva three-phase generator in service in the power station at Vessy may be considered as a typical specimen of the units used in small industrial power stations. Entirely constructed by electric arc welding, this elegant and at the same time robust machine has its voltage adjusted by a Secheron Simplex regulator.

A somewhat more powerful unit, 210 kva, is installed at the Usines Tornos, at Moutier (Switzerland). Very analogous to the preceding machine, this one is also driven by a Kaplan water turbine.

Where such firms have no water power available, they often install a-c or d-c generators driven by Diesel engine. This has been the case at the Luther Brewery, at Bucharest, in Rumania, where Secheron has supplied a 500-kw direct-current generator.

For the cloth mills of Hefti & Cie., at Hatzingen (Switzerland), Secheron has supplied all the electric equipment for a 430-kva power station. The generator, driven by a Kaplan turbine, is also entirely constructed by welding. It is controlled from switchboards fitted with the requisite appliances for regulating, synchronizing and setting in parallel with the neighboring supply system.

A particularly interesting power station is that equipped for the firm G. Scolari S. A. at Derendingen (Switzerland), makers of paste goods. The generator, of 420 kva capacity and constructed entirely by welding, is also driven by a hydraulic turbine. This plant is interesting from the fact that the regulating of the frequency has been

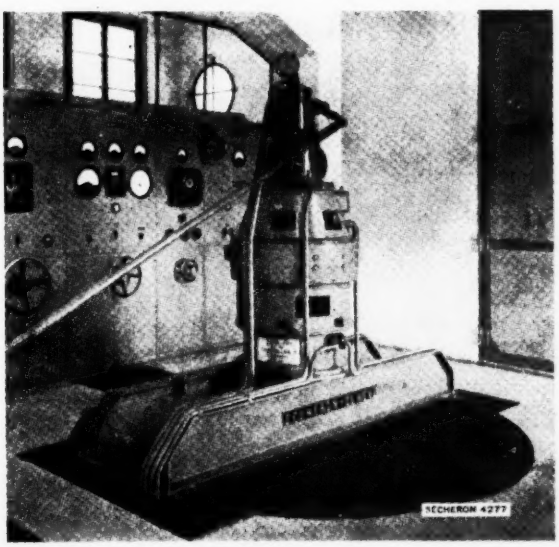


Fig. 2. Power station of the S.A.G. Scolari, Derendingen (Switzerland). The power station of these makers of paste goods is equipped with a three-phase generator of 420 kva at 400 volts, 214 rpm. The automatic regulating of the frequency is effected by a Secheron Simplex regulator

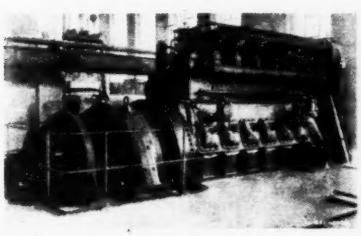


Fig. 4. Direct-current generator 500-kw, 110 volts, 375 rpm, driven by a Diesel engine. This unit is installed in the private power station of the Luther Brewery, at Bucharest

solved in an elegant manner by the incorporation of an electric boiler. Since this plant has no means of accumulation, the power available must be used up as far as possible, any surplus beyond what is required in the works being absorbed by the electric boiler. Since neither the power available nor the consumption are constant, it is necessary to be able to regulate the absorption by the boiler as a function of the power available and of the consumption in the works. This automatic regulating of the frequency is effected by a regulator of the Secheron Simplex type.

In addition, this plant must also work in parallel with a supply network, to which it can also deliver the surplus energy produced.

For the Compania Textil de Santa Basilissa in Brazil, Secheron has supplied two 530-kva three-phase generators, with horizontal shaft, driven by hydraulic turbines of the Francis type. The installation includes also the requisite instrument and control panels fitted.

From this brief account we can see that, whatever the hydraulic conditions may be, the designer has to seek and can find a solution which will enable him to obtain the maximum possible from a plant which must be characterized principally by its great simplicity, by the ease with which the different members can be controlled, by ready response to maneuvering, and above all by its robust construction. In short, it must always be kept in mind that, for a firm that has decided to provide its works with a private power station, reliability in service is a matter of primary importance.

Questions and Answers

Question No. 427

HOW HANDLE CHLORINE CYLINDERS?

BECAUSE so many power plants use chlorinating equipment for chlorinating condenser circulating water, I should like to know what some of the problems are in handling the chlorine employed for this purpose. This chlorine is usually delivered in cylinders. It will help me in making plans for a new plant if Q & A readers can comment on the following:

1—What are recommended methods for handling cylinders of chlorine from railway cars or auto trucks in which they may be delivered to the plant?

2—What handling equpiment is required—cranes, platforms, industrial cars on rails, hand drawn trucks, monorail hoists?

3—Should chlorine cylinders be protected from weather while in storage or would a system of outdoor storage racks be satisfactory? What effect would hot summer sunshine, zero winter weather, rain or snow have on the safety or convenience of handling cylinders?

4—Should operators wear gas masks while replacing cylinders and making connections to the chlorinating piping system?

I understand that conditions will differ in different plants, hence it may not be possible to give general recommended practices that would fit all situations. If not, how about data on what is done in specific cases, which I might adapt to my problem in case they are similar?

Chicago, Ill. P.H.

Question No. 428

WOULD CONSTANT PILOT ADD TO GAS FIRING SAFETY?

BECAUSE in view of the fact that gas explosions of boilers equipped with safety devices have occurred, I should like to ask Q&A readers these questions.

A 150-hp gas-fired boiler is equipped at present with a flame failure protection system using the flame conduction principle, and a spark-plug-igniting gas pilot. The pilot is off when the gas burner is on.

Is an additional constant pilot desirable and how does it add to safety? If desirable, how should it be placed with relation to the flame rod and burner?

Would a constant pilot that burns large quantities of gas, say 1 per cent to 1½ per cent of the maximum burner capacity, give as good results as a smaller pilot of "burner type" that cannot be blown out by draft?

Would you keep the constant pilot burning at all times when gas-fired boilers are shut down at night or week ends, to prevent explosions from possible gas leaks into the building or boiler?

Chicago Ill. Z.K.

Answer No. 417

WHAT SUPPORTS THE WEIGHT OF THE PISTON?

With Tail Rod, Two Crossheads; Without Tail Rod, Cylinder Wall says Benton

E.A.N. is mistaken in his view that the weight of the piston should never be supported by the cylinder walls, but by the adjustment of the crosshead and tailpiece. In the design and construction of a steam engine cylinder and frame, it is provided that the center line of the cylinder bore and the center line of the crosshead guides be exactly in line; the packing box for the piston rod packing is bored through to this same center line. The piston is turned to a running clearance fit in the cylinder bore and the area of the piston outside diameter surface, exclusive of the piston ring surface area, is such that one-half of this outside diameter piston surface area is sufficient to support the weight of the piston without causing undue wear on the cylinder wall or the piston surface.

It is intended that the weight of the piston per square inch of piston surface area bearing on the bottom half of the cylinder bore will be such that it will not break down the film of lubrication between the piston and the cylinder wall. It is intended that the piston should reciprocate so that the piston rod and the cross head, when properly aligned, will make a straight line travel without lateral motion in the packing box.

After years of service and, perhaps, from time to time with limited lubrication, the piston and cylinder bore will wear. This allows the piston rod to gradually run at a lower level than the exact center of the cylinder bore. In so doing the underside of the piston rod rubs on the bottom of the packing box throat, so that these surfaces also wear.

I have known cases where dovetail grooves have been turned in the outside diameter of a piston and these grooves poured full of Babbit thoroughly peened tight into the groove; after which the Babbit was turned to fit the cylinder bore. This was done in an effort to provide wearing surfaces to carry the weight of the piston and reduce the tendency to cylinder wall wear.

All the foregoing comments have to do with the design and operation of steam engines of sizes such that they do not have a piston rod extension through the head end of the cylinder, with a suitable crosshead provided for the rod extension, usually called a tail rod. Where these tail rods are provided, then the piston rod is of such size as to carry the weight of the piston on the main crosshead and the tailrod crosshead.

HARRY W. BENTON

West Hartford, Conn.

PRACTICAL ENGINEER SECTION

Answer No. 419

HOW SHOULD HE INSTALL THIS FUSIBLE PLUG?

SUGGESTION for installing a fusible plug in a pipe outside the boiler was made to him by a boiler inspector, said L.F. in the June issue. He has three hrt boilers in a dairy and ever since stokers were installed under them, his fusible plugs blow out frequently.

There is only about 26 in. between the rear heads and the rear wall of the setting; and L.F. and the inspector feel that this is not enough and that the hotter flue gas from the stokers may be keeping the rear heads hotter than they used to be, thus causing the plugs to melt faster. L. F. wanted to know if a plug installed in a pipe outside the setting would be as safe as the rear head plug.

In the July issue, C. C. Custer commented on the construction of plugs and their installation, recommending more care in selection and use of them. Here are two more comments: one shows that plugs long on the water side will conduct the heat away faster; the other shows how low water is always the cause of plug failure, and describes a case of plug failure and its cause.

Use Extra Long Plug End on Water Side, Suggests Moulton and Tells Why

L. F.'S TROUBLE in burning out fusible plugs is, no doubt, due to the increased temperature of flue gases generated by the spreader stokers in the back connection of his hrt boilers. However, it seems to me that it could be remedied without making any changes in the boiler settings, or in the operation of the stokers that would reduce the boiler capacity..

First, it would be well to make sure that the cause is not due to low water. But no doubt L. F. has already checked that; and since his boilers are very clean there is no scale or incrustation of any kind surrounding the inside end or projection of the plug that could cause overheating of the fusible metal, which is usually almost pure Banca tin.

When a fusible plug is blown in any boiler at any time, someone always jumps to the conclusion that it was due to low water. But this is not always the case. Sometimes a good clean plug well covered by water will blow for no apparent reason. Why? Well let's consider the conditions it must work under. It has one end exposed to the hottest gases of combustion, part of it is in contact with the shell of the boiler, and the inside projection is surrounded by the water in the boiler.

In Massachusetts, the State law requires that the plug project through the shell or drum at least 1 in. in the clear. It can be made longer and there are extra long plugs on the market.

The object of the part sticking through into the water is to act as a radiator—that is, to carry away the heat from the part exposed to the furnace heat.

If anyone doubts this, let him saw off this part of the plug, put it in operation and see just how long it takes to burn it out. And he won't have to wait long to find out!

Now it seems to me that L.F.'s trouble could be overcome by putting in fusible plugs with extra long inside ends that would carry away the heat from the hot end much faster, also screwing them into the boiler head as far as is proper to do so, in order to expose as little of the plug as possible to the heat of the flue gases.

Pittsfield, Mass. ALBERT H. MOULTON

Keep Plug Wet and It Won't Melt, Says Hudson

The writer has never known a fusible plug to fail from any other cause than low water; if it is kept wet it will not melt. The leaky tube condition referred to by L. F. seems to confirm this probability.

The first step in solving the problem would seem to be a thorough check of fusible plug location with respect to the lowest visible portion of the gage glass and the proper height above the top row of tubes.

Laws governing these points, if any exist in his state, will determine these points.

Another thing that might be a factor is circulation of water in the boiler under hard steaming conditions. It could be possible that the water may be an inch or two lower at the fusible plug than is indicated by the gage glass.

As to relocation of the fusible plug, L. F. should be governed by such laws as exist. The writer recalls seeing, many years ago, a fusible plug mounted on top of the water column of a Scotch marine boiler. A small pipe extended downward through the top of the column, with its lower end terminating at the lowest safe water level. The fusible plug was installed at the top of this pipe, where it extended above the water column. With a normal water level this pipe would be full of comparatively cool water; but if the water level fell to a point below the submerged end of the pipe, hot steam would fill the pipe and melt out the plug.

The melting point of such a plug would have to be quite low and the writer has no idea where such a plug could be purchased. A valve between the top of the water column and the plug allowed renewal in case of failure. This location and method of installation of a fusible plug is questionable, in the writer's opinion, for too many things could happen to defeat the purpose of such a fusible plug, which is to protect the boiler from damage.

The writer recalls a low-water experience which occurred in a plant where he was employed several years ago. Several vertical fire-tube boilers were installed in a row; all were hand fired. One Monday morning, the chief ordered one of the boilers to be brought up from cold and put on the line.

Three licensed firemen were on duty at the time, one of whom had been employed that morning. He was assigned to bring up the cold boiler and the experienced man on each side was instructed to keep an eye on him. The chief was busy with a fire in the coal pile at a hatchway a few feet away. Hearing a little commotion, he looked around and saw one of the firemen mounting a step ladder to open the master feed valve where the feed pipe entered the boiler.

Inquiring as to what was wrong, the fireman said, "There is no water gage glass." Don't open that valve," ordered the chief, who knew that the water level had been at the proper point before a fire was started in the furnace.

A spray of water from a small hose quenched the furnace fire; drastic treatment but warranted in this case. Immediate inspection of the blowoff valves, as soon as the fire was out, revealed them closed. Of course, no one knew how the water got out of the boiler.

When the boiler had cooled sufficiently, the handhole plate, where the fusible plug was installed in a tube, was removed; no water was found there, and, of course, the plug had melted.

A plate was removed at the crown-sheet line; it too was dry, likewise the mudring. The ends were burned off on 18 tubes and the furnace sheet had bulged in about 1 in. over the fire door.

The firemen were not of much assistance in reconstructing what had happened; everyone was covering up.

This seems to be what happened: As the water warmed up it swelled in volume, and in a vertical boiler the rise in water level is abnormal. Noting the rise, one of the firemen must have opened the blowoff valves to bring the water level down, and must have forgotten to close them. In the confusion of getting the fire quenched, the guilty party sneaked around behind the boiler and closed the blowoff valves. Since the blowoff discharge was several hundred feet away, the chief had not noticed that the boiler was being blown down.

The thought of what might have happened had the fireman opened the master valve and admitted water to the boiler is not pleasant to contemplate.

Plymouth, Mass. C. BROOKS HUDSON

STANDARD SIZES OF RIGID METAL CONDUIT AND NUMBER OF R, RP, RH, RW AND V CONDUCTORS IT WILL CARRY — 600 VOLTS *

STANDARD SIZES OF CONDUIT
For the Installation of Wire and Cable

In addition, the following exceptions are permitted where the run of rigid conduit or electrical metallic tubing does not exceed 50 feet in length and does not contain more than the equivalent of two quarter bends from end to end: Three No. 6 stranded or six No. 8 solid conductors in a 1-inch conduit. For services only, two No. 6 Type R wire and one No. 6 bare wire, or two No. 4 Type R wire and one No. 4 bare wire in a 1-inch conduit. Or two No. 2 Type R wire and one No. 2 bare wire in a 1¼-inch conduit.

The following table applies only to complete conduit systems and does not apply to short sections of conduit used for protection of exposed wiring from mechanical injury.

TWO-WIRE AND THREE-WIRE SYSTEMS

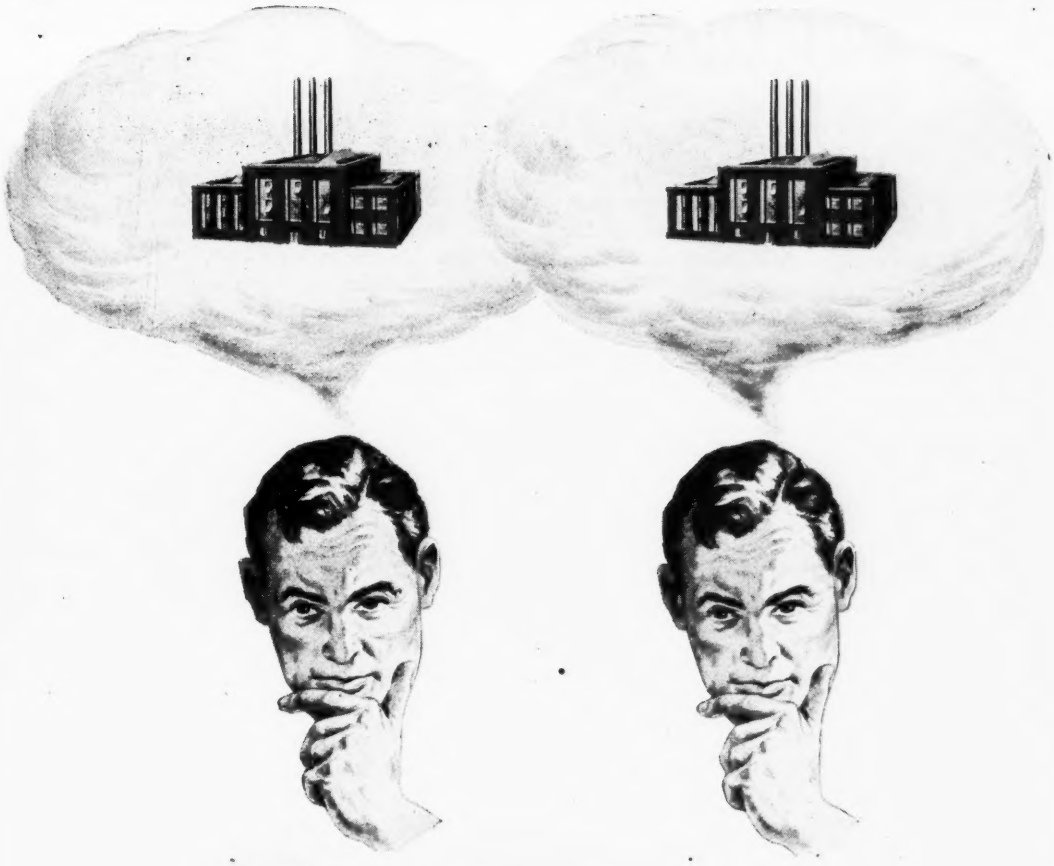
Size of Wire	No. of Wires in One Conduit: 1	2	3	4	5	6	7	8	9
	Minimum Size of Conduit in Inches								
14	½	½	½	½	¾	¾	¾	1	1
12	½	½	½	¾	¾	1	1	1	1¼
10	½	¾	¾	¾	1	1	1¼	1¼	1¼
8	½	¾	1	1	1¼	1¼	1¼	1¼	1½
6	½	1	1¼	1¼	1½	1½	2	2	2
5	¾	1¼	1¼	1¼	1½	2	2	2	2
4	¾	1¼	1¼	1½	2	2	2	2	2½
3	¾	1¼	1¼	1½	2	2	2	2½	2½
2	¾	1¼	1½	1½	2	2	2½	2½	2½
1	¾	1½	1½	2	2	2½	2½	3	3
0	1	1½	2	2	2½	2½	3	3	3
00	1	2	2	2½	2½	3	3	3	3½
000	1	2	2	2½	3	3	3	3½	3½
0000	1¼	2	2½	2½	3	3	3½	3½	4
200000 C.M.	1¼	2	2½	2½	3	3	3½	3½	4
225000	1¼	2½	2½	3	3	3½			
250000	1¼	2½	2½	3	3	3½			
300000	1¼	2½	3	3	3½	3½			
350000	1¼	2½	3	3½	3½	4			
400000	1¼	3	3	3½	4	4			
450000	1½	3	3	3½	4	4½			
500000	1½	3	3	3½	4	4½			
550000	1½	3	3½	4	4½	5			
600000	2	3	3½	4	4½	5			
650000	2	3½	3½	4					
700000	2	3½	3½	4½					
750000	2	3½	3½	4½					
800000	2	3½	4	4½					
850000	2	3½	4	4½					
900000	2	3½	4	4½					
950000	2	4	4	5					
1000000	2	4	4	5					
1100000	2½	4	4½	6					
1200000	2½	4½	4½	6					
1250000	2½	4½	4½	6					
1300000	2½	4½	5	6					
1400000	2½	4½	5	6					
1500000	2½	4½	5	6					
1600000	2½	5	5	6					
1700000	3	5	5	6					
1750000	3	5	5	6					
1800000	3	5	6	6					
1900000	3	5	6						
2000000	3	5	6						

For groups or combinations not included in the above table, consult the Authority enforcing the Code. For such groups or combinations, it is recommended that the conduit be of such size, that the sum of the cross-sectional areas of the several conductors will not be more than 40 per cent of the interior cross-section area of the conduit.

This data is in accordance with the National Electrical Code Regulations of the National Board of Fire Underwriters for Electric Wiring as recommended by the National Fire Protection Association and approved by the American Standards Association.

Chart, Courtesy of Lincoln's Industrial-Commercial Electrical Reference

*The letters R, RP refer to the type of insulation as follows: R, Code grade rubber. RP, Performance grade rubber. RH, Heat resistant rubber. RW, Moisture resistant rubber. V, Varnished cambric.



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BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

Where Will Ultrasonics Fit in the Power Field?

High intensity sound vibrations now being used or proposed for various purposes in large-scale industrial processes . . . Produced by new mechanical sound generator capable of high energy output . . . New type of sonic collection system for recovery of liquid or solid particles from gas streams . . . Power engineers watch sonic collection to see if principles may have applications in cleaning fly ash from flue gas, in improving combustion, in soot-blowing, or even in water treatment . . . Experimental installation in large power plant . . . Details of carbon black collection . . . Chemical recovery on paper mill recovery unit . . . Ultrasonics in paper drying . . . Uses in metal testing and soldering . . . Possibilities in power plant not yet determined but are being studied

By CHESTER R. EARLE, Managing Editor, POWER GENERATION

POWER ENGINEERS everywhere, reading all sorts of references to new industrial uses of sound vibrations, are beginning to separate the wheat from the chaff and to watch very closely some of the new developments now under way in the field of high-intensity sound waves, often referred to as ultrasonics. Chief of these new developments is a mechanical method of producing sound waves of high enough intensity to be used in large-scale industrial processes. Use of such vibrations in the collection of carbon black is one of the first commercial applications of the method and the success of the method in this field has led to experiments with it in other fields, as detailed below. Since operations like flue dust collection are in some respects similar to carbon black collection, the reason for the interest is obvious.

It has gone so far that an experimental installation of the new method has been made for flue gas cleaning in one of the country's most famous power plants. Newspapers and magazines have carried stories of experiments planned for dispelling fog by ultrasonics on the Maine coast. What supersonic vibrations are capable of doing in industry, as they are now being tested in paper mills in Maine and Louisiana, in a power plant in Massachusetts and another in the Middle West, is being watched with keen interest all over the country. Where they will fit in the power field is yet to be determined but apparently worth study.

Previous Uses of Sound Waves

Up to a year or so ago, uses of high-frequency sound waves in industry, while fairly extensive, involved very low amounts of energy, were mostly of the laboratory or testing type of application. Sonar detection of submarines, small-scale liquid emulsification, detection of flaws in metal parts, measurement of wall thickness of piping or tanks —these are familiar to many engineers.

Vibrations used in these applications are produced usually by (1) piezoelectric crystals, transforming high-frequency electric potentials into mechanical vibrations[1], or (2) magnetostriction devices[2] in which a high-frequency electromagnetic field causes a rod or diaphragm to oscillate at high frequency. But these devices do not produce vibrations with sufficient energy to produce effects in the large bodies of gases and liquids handled in most industrial processes today.

Now, however, with the development of a powerful new mechanical sound generator, shown in Fig. 1, capable of emitting large amounts of sound energy at high frequency, the entire picture has changed.

[1] A great deal of fine investigation in the pure science of acoustics has been done with these devices; those interested should consult the proceedings of the Acoustical Society of America. At its meeting in Washington in April 1948, the Society heard a number of papers not only on methods of producing ultrasonic vibrations, but also on various methods of using them to determine velocity of sound in gases, action of ultrasonic vibrations in metals and the like.

Aerosol Agglomeration by Ultrasonics

The most important application of this generator to date has been in aerosol agglomeration. Since flue dust collection is akin to this process, it has aroused the attention of power engineers, in view of the prevailing pressure on them for clean smokestacks. It has also aroused much attention in industry where recovery of valuable chemicals from gases, or the suppression of noxious exhaust fumes, or both, have been economic and public relations problems.

Aerosol agglomeration by ultrasonics—sounds like a new language.

[2] In Report of Investigations RI 3480, January 1940, the Bureau of Mines described a magnetostriction vibrator used in development of a sonic flocculator for settling smoke, mists, and fumes. This device produced sound radiation that could be felt with the hand at a distance of 18 in. from the vibrator and could support a small shot or a penny in the air. Considerable work was done by the Bureau on aerosol collection before the war.

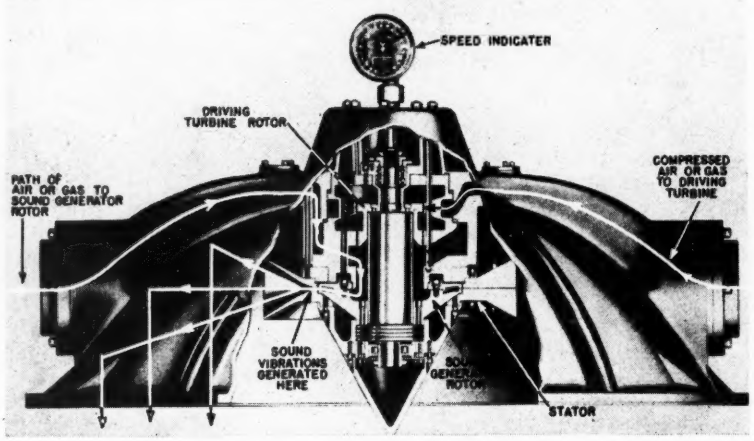
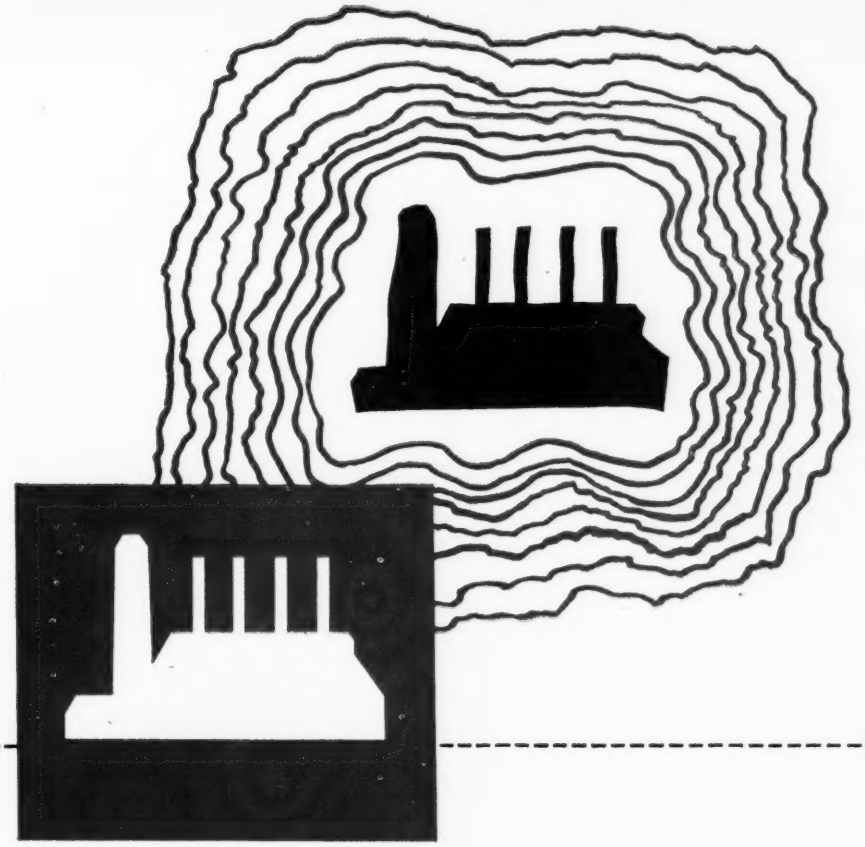
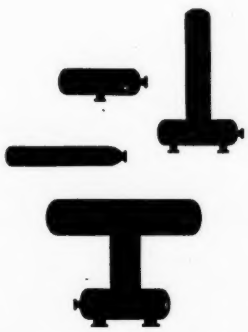

SPEED INDICATER
DRIVING TURBINE ROTOR
PATH OF AIR OR GAS TO SOUND GENERATOR ROTOR
COMPRESSED AIR OR GAS TO DRIVING TURBINE
SOUND VIBRATIONS GENERATED HERE
STATOR

Fig. 1. Cutaway view of sound generator. Gas or air turbine drives rotor. Gas or air issuing through ports in siren rotor and stator is chopped into pulsations, creating sound vibrations of frequencies up to 200,000 cycles per second, intensities up to 170 decibels. Vibrations reflected into an agglomerating or acoustic chamber where high energy of sound is used up in causing small particles in aerosol to build up into larger particles, which can be collected mechanically by cyclone separator



R for Plant Palsy*

* *Due to pulsative gas flow*



Fluor Pulsation Dampeners are "tailor-made" to fit every specific requirement.

"Plant Palsy"... vibration due to pulsative flow in gas, air or vapor pipe lines... is an entirely too frequent industrial ailment.

The ideal prescription for this malady is the Fluor Pulsation Dampener. It converts pulsative flow into a smooth, steady stream. It reduces friction losses. It permits stepped-up rate of flow. It increases horsepower efficiency. Pipe line breakage due to excessive vibration, with subsequent danger of explosion and costly shutdown, is largely eliminated. Moreover, accurate meter readings are made possible. The unit has no moving parts; hence no maintenance attention or expense.

If your plant is suffering from "palsy" due to pulsative flow, let Fluor show you the effectiveness of the Fluor Pulsation Dampener... as proved by hundreds of satisfactory installations!

FLUOR | **PULSATION DAMPENERS**

PRODUCTS | *Cooling Equipment, Mufflers, Gas Cleaners, Pulsation Dampeners*

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THE FLUOR CORPORATION, LTD., *Los Angeles 22* · NEW YORK · PITTSBURGH · KANSAS CITY · HOUSTON · TULSA · BOSTON

And in a way it is, for a new nomenclature goes with the new science of high-frequency, high-intensity sound. Let's translate.

An aerosol is a stream of gas in which are suspended fine liquid or solid particles, usually below 10 to 15 microns[1] in diameter. An industrial smoke, mist or fume is an aerosol.

Aerosol agglomeration is the process of causing the fine particles in a gas stream to stick together to form groups of such size that they may be readily collected by cyclone separators. Aerosol agglomeration by ultrasonics, or sonic collection, is a method of agitating the fine particle by high-intensity sound waves of from 15,000 to 18,000 cycles per second (the upper limit of most human hearing) up to about 200,000 cycles per second and of extremely high intensities, so that the fine particles will stick together and form large particles or droplets.

Many methods are available for solving the problems of aerosol particle recovery. Scrubbing towers and the new venturi-scrubber, electrostatic precipitators, bag filters, mechanical cyclone type separators, or combinations of them, are typical means applied under varying conditions. Their application under these various conditions depends largely on cost factors. In particular, the smaller the particles in the aerosol, the more difficult and costly it is to collect them.

New Mechanical Sound Generator

Since the end of the war, a new method of applying ultrasonics to large gas volumes has been developed—a purely mechanical sound generator made by Ultrasonic Corp. This sound generator is essentially a high-speed gas or air siren driven by a gas or air turbine. In the siren, compressed gas or air from an appropriate source is passed into an annular chamber surrounding a rotating shaft, to which is fastened a slotted rotor. The compressed gas passes radially outward through the slots of the rotor and then through slots or stationary vanes of a corresponding concentric stator. See Fig. 1.

During operation, the gas passage is alternately opened and closed, cutting the gas stream into short pulses and producing the ultrasonic vibrations in the stator ports. These high-intensity sound vibrations are focused by horns in the stator and directed to a reflector, which in turn directs the vibrations along the axis of the siren and into the agglomerator tank as required by the application.

Frequency of the sound waves is determined by the speed of rotation of the siren. This can be varied because the driving turbine is a variable-speed unit. Amount of air or gas forced through the generator determines the intensity of the sound waves and this too can be easily varied. The standard sound generator unit produces frequencies from 11,000 to 200,000 cycles per second, with intensities from about 100 to 170 decibels. The unit converts from 50 to 70 per cent of the energy in the compressed gas into sound energy.

[1] A micron is 0.001 mm = 0.00004 in. = 1/25,000 in. Hence a 10-micron particle has a diameter of 0.0004 in.

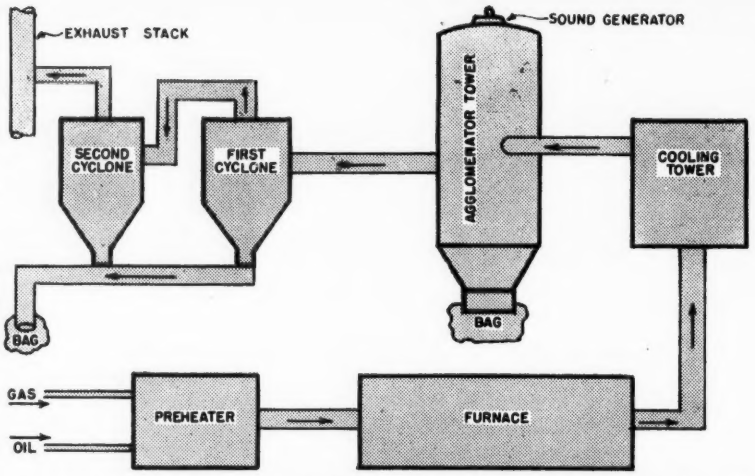

Fig. 2. How sound generator is installed for collection of carbon black particles. Gas containing carbon black particles passes into agglomerator tower, ultrasonic vibrations from generator directed down into tower cause particles to adhere and form larger particles, which are removed in first and second cyclones

How Sound Generator is Installed

In collecting particles from gas streams, the sound generator is mounted on top of a vertical tank or tower and the sound vibrations directed downward into the tank, through which is passed the gas to be cleaned. The sound energy is, of course, absorbed by the particles and not by the tank or other equipment.

For experimental work in treating liquids, a special liquid curtain attachment, not shown here, has been developed. For fog-dispelling, an extension to the parabolic reflector is employed.

The generator unit can be made in any size or capacity required to suit various quantities of gas.

How Sound Waves Cause Particle Agglomeration

The physical theory behind the action of the sound waves, in causing small particles in an aerosol to agglomerate, is somewhat complex and will not be given here in detail. Briefly, the action of the sound waves is to produce differences in velocity between particles, thus making them collide. The sound waves, by increasing the velocities of different-sized particles, cause more frequent collisions. Sound waves may be used to build up agglomerations of most solid dry aerosol particles until they have a settling rate of ½ cm per sec or more, with a diameter of 15 to 100 microns or larger. These can be readily separated from a gas stream by cyclone separators. There is, however, a limit to the size to which an agglomerate can grow before it again becomes unstable. Where aerosol particles are moist or composed of adhesive materials or are liquid particles, they can be agglomerated to larger sizes.

In general, sound wave agglomeration finds application where the particle diameters are below 10 to 15 microns and where the concentration is not lower than 2 grains per cu ft.

Frequency is selected that will cause the greatest difference in particle velocities, but intensity of 160 decibels or more must usually be employed to agglomerate most aerosols. Consequently, although the sound generator equipment is fairly standardized, each installation must be individually engineered to secure best collection method and optimum effectiveness, depending on existing conditions of grain loading, temperature, gas flow and the like, with lowest capital investment.

Sonic Collection of Carbon Black

One of the first industrial applications of the sonic collection system using the new sound generator was a pilot plant for collecting carbon black at the plant of Godfrey L. Cabot, Inc., at Pampa, Texas. The operation of this pilot plant has been so successful that a full-scale commercial installation is now under construction there.

In the pilot plant installation, diagrammed in Fig. 2, about 2000 cfm of gas is passed through the agglomerator tower, (the acoustic chamber) where the fine carbon black particles are collected, the sound vibrations being at a frequency of approxi-

(Continued on page 132)

Test Control

IS IMPORTANT

In Your Own Boiler Plant

A part of Dearborn engineering service is the recommendation of the correctly worked out test control procedure for your particular plant. Test control is the most important factor in boiler water conditioning and is the only means for adjustment and treatment. Blowdown and operating difficulties are avoided if the correct chemical balances are maintained at all times. This is the function of control testing.

The Dearborn Service Engineer is prepared to discuss this phase of water treatment with you. Call him or write to us direct, and we will see that he gets in touch with you.

The Dearborn Engineer works with plant personnel. Carries his own equipment or uses yours for on-the-spot tests.

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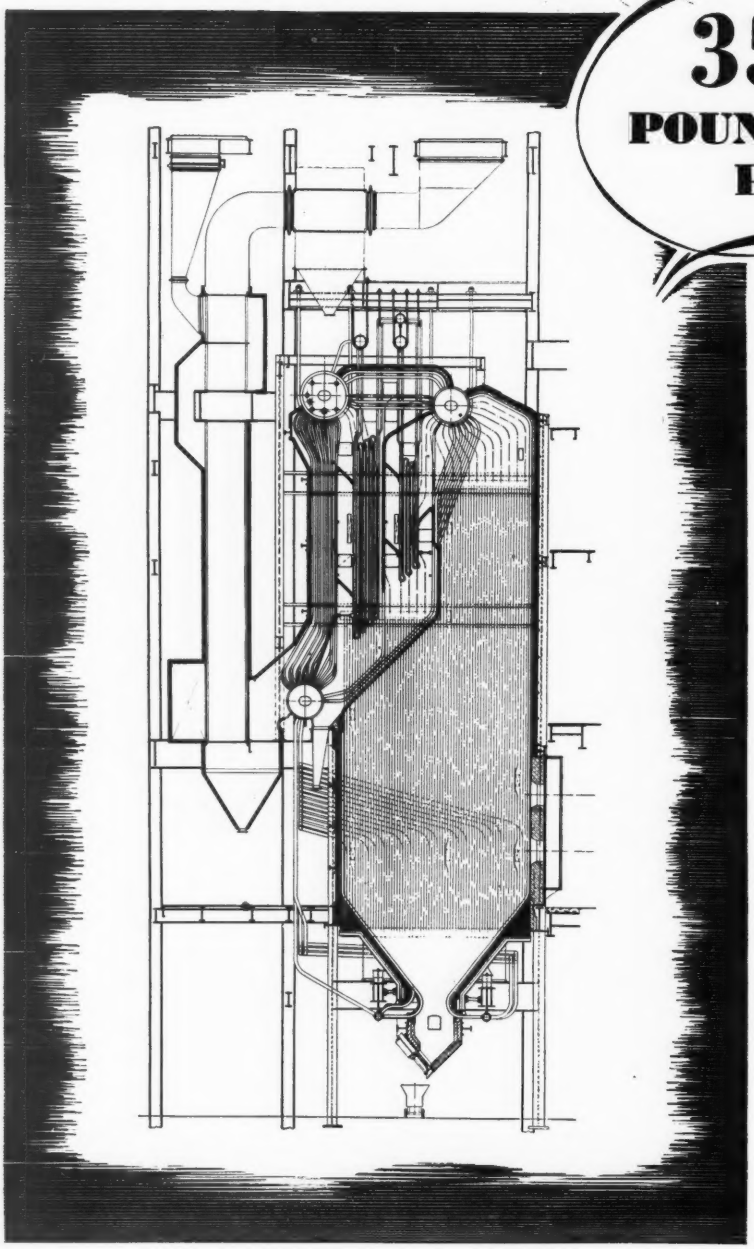
350,000
POUNDS OF STEAM PER HOUR



Purchaser—
Minnesota Power & Light Co.

Location—
Duluth, Minn.

Number of Boilers.....1

Type of Boiler
Erie City 3-Drum
Steam Generator

Pounds of Steam/Hr. 350,000

Design Pressure....1025 PSI

Operating Pressure . 925 PSI

Steam Temperature.. 905° F.

Water Walls.....Erie City
Bare Tube

Air Heater.....Erie City
Tubular

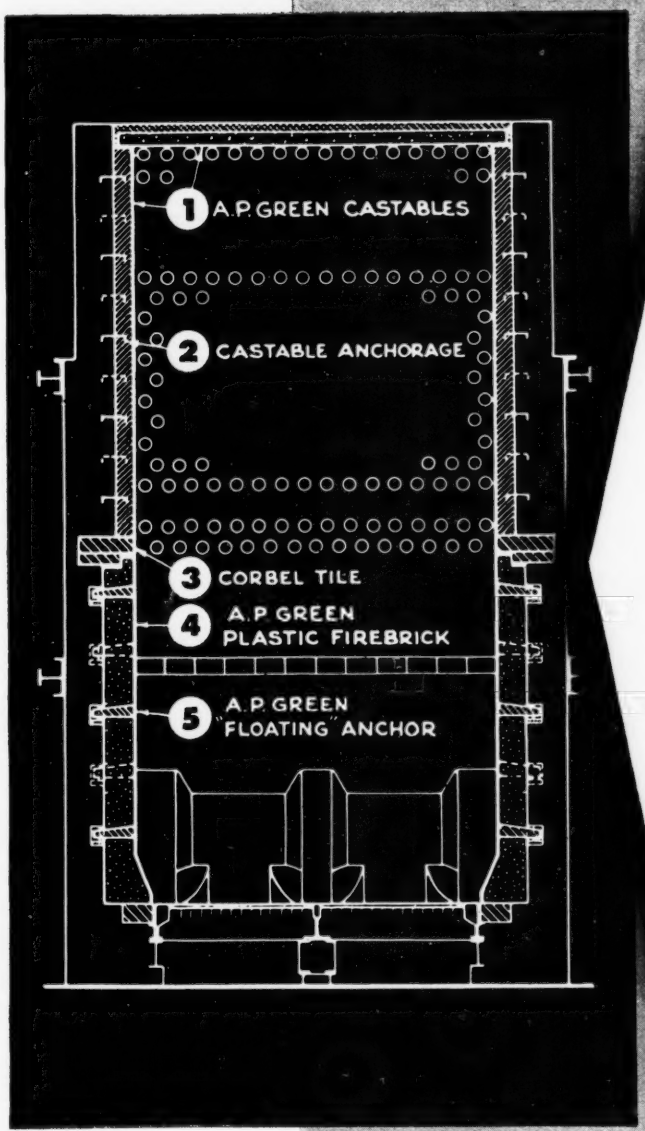
STEAM POWER PLANT EQUIPMENT

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY
SINCE 1840

ERIE CITY IRON WORKS • ERIE, PA.

WHY A. P. Green Monolithic Construction?



1 A. P. GREEN CASTABLES*

Upper sections of furnace linings must be airtight to obtain efficient and economical operation. A. P. Green castable monolithic construction stops air infiltration. Castables are easily installed in old or new settings.

*KAST-SET® and KAST-O-LITE®

2 CASTABLE ANCHORAGE

The one-piece castable wall is anchored securely to the outer wall — bulging or pulling inward is stopped. Longer, more trouble-free service is assured.

3 CORBEL TILE

Corbel tile support the castable lining, making it independent of the lower furnace walls. The upper section is not disturbed when maintenance work is done on the furnace proper.

4 A. P. GREEN PLASTIC FIREBRICK*

A. P. Green monolithic plastic furnace linings present an unbroken surface. There are no vulnerable joints exposed to destructive furnace elements. Plastic construction is exceptionally airtight and resistant to spalling. With proper supervision, plastic walls are easily installed even with inexperienced labor.

*A. P. Green SUPER-PLASTIC and PLASTIC Quik-Pach®

5 "FLOATING" ANCHORS

In monolithic construction, expansion and contraction are provided for by the use of A. P. Green "floating" anchors. These anchors permit free wall movement, both horizontal and vertical, yet provide positive anchorage to outer wall. BULGING is eliminated.

No single refractory material is applicable to all temperatures and types of service. A. P. Green produces SUPER-PLASTIC to meet certain extreme conditions — PLASTIC Quik-Pach to meet requirements of a high heat duty refractory — KAST-SET where a high quality refractory castable is desired — KAST-O-LITE for zones where a lightweight castable refractory with insulating properties is necessary.

Call your local A. P. Green distributor or write direct for more information on these and other A. P. Green refractory products.

A. P. Green REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK COMPANY

MEXICO, MISSOURI, U. S. A.

A. P. GREEN FIRE BRICK CO., LTD. IN CANADA

DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE WORLD

Good news about J-M's new Ramie Fiber packing!

NAVALON is stronger because it's made of nature's strongest fiber

NAVALON IS GOOD NEWS for you . . . because it is made of RAMIE, the strongest of all natural fibers . . . the fiber that actually becomes *stronger* when wet.

GOOD NEWS because Navalon's inherently tough characteristics actually make it highly rot-resistant. Navalon, therefore, performs outstandingly in service against fresh or salt water, brine, cold oil, and many other liquids.

GOOD NEWS because Navalon is abrasive-free . . . *contains* more lubricant . . . and *retains* more lubricant in service. Thus, Navalon reduces shaft wear to a minimum—is ideal for use on pumps, elevators, accumulators, presses and reciprocating rods.

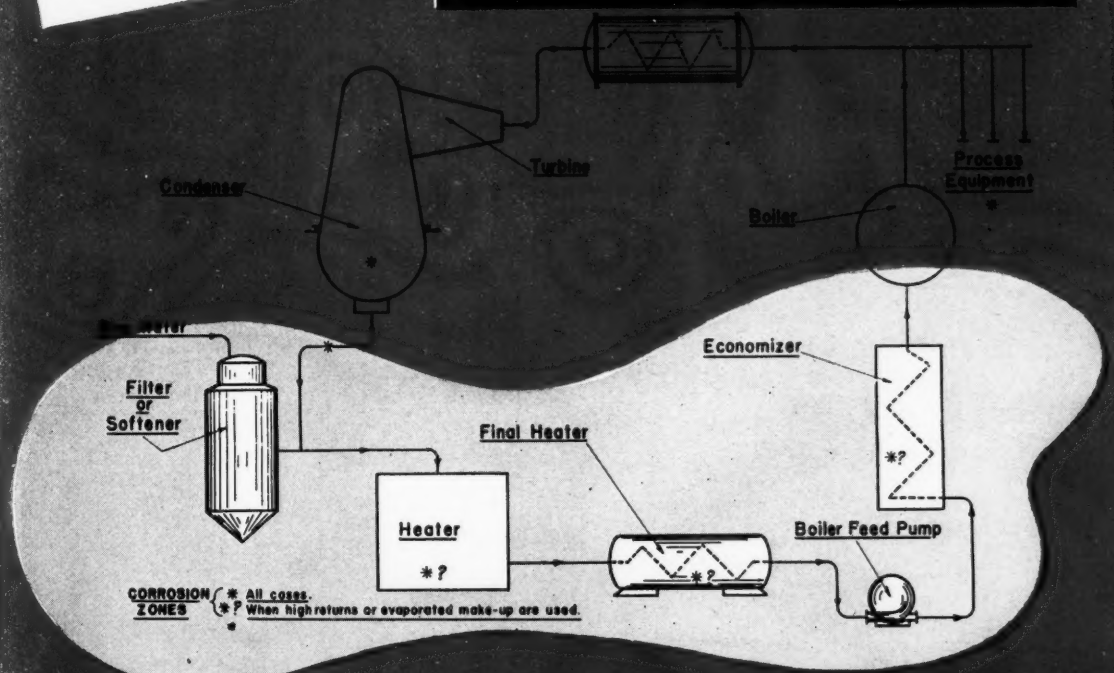
GOOD NEWS because Navalon is made by a new, exclusive J-M process especially for industrial use . . . is available in the sizes—both coil and spiral—to meet nearly every industrial requirement. See your Supply House about Navalon and other J-M packings, or write to Johns-Manville, Box 290, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville **PACKINGS & GASKETS**

Is your plant operation suffering from Water Treatment problems—

in the Feedwater System?



Serious production delays and high maintenance costs can result from either or both of the following problems commonly encountered in feedwater systems:

CORROSION—May result from presence of dissolved oxygen or from either high or low alkalinity. A type of failure sometimes referred to as corrosion-erosion is especially important in the case of feed pumps.

FEEDLINE DEPOSITS—Water entering the system often contains suspended material that may lead to deposits. More commonly, however, deposits are caused by precipitation of bicarbonate hardness as the water is heated, or through precipitation by water treatment chemicals.

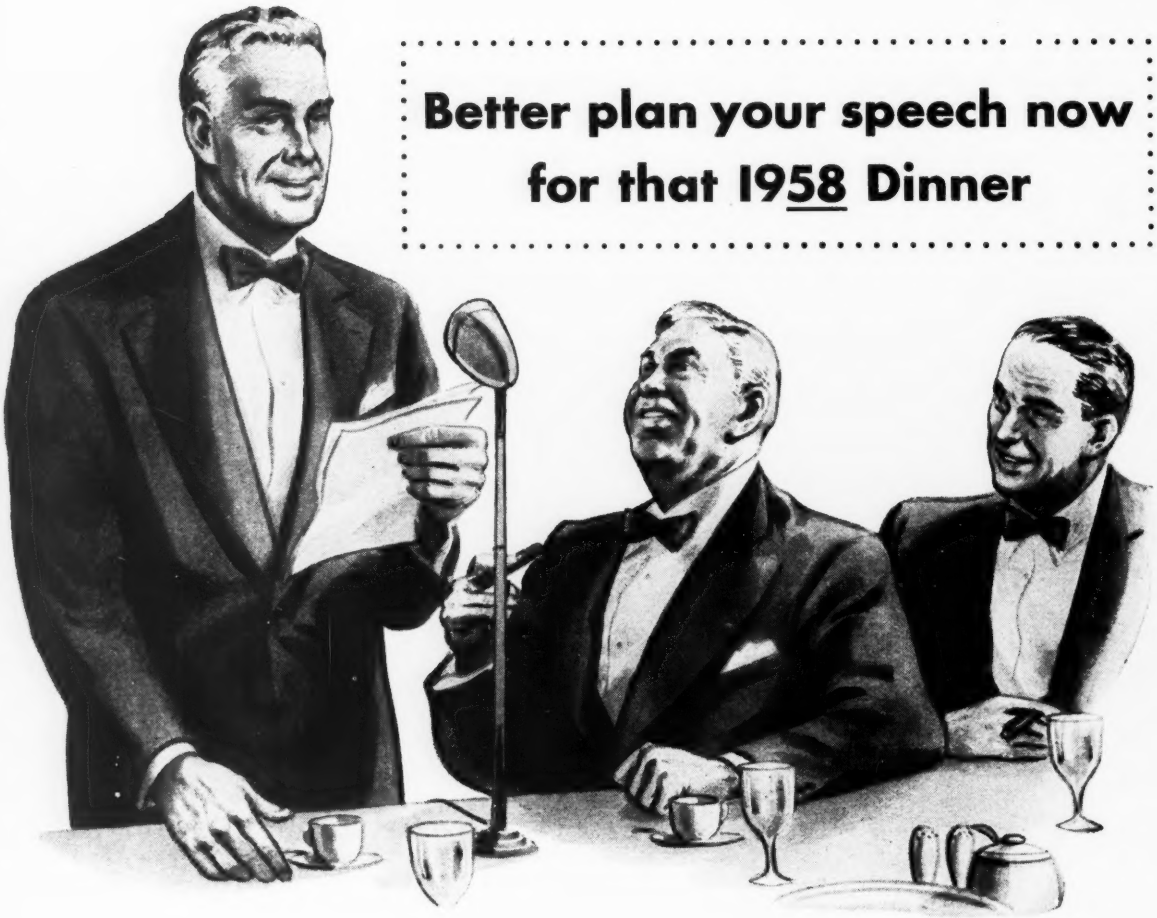
In order to eliminate both of these problems, proper water treatment must be instituted. This may range from internal treatment, which is necessary in practically all cases, to pretreatment, which is often required in addition. For the elimination of corrosion, corrective steps may range from simple pH regulation to re-circulation of boiler water. Proper deaeration and gas removal also are required. For the elimination of deposits, proper feeding of internal boiler water treatment must be practiced and in many cases, continuous addition of organics may be necessary.

Some of these difficulties are probably present in your plant. Your local Drew Engineer will be glad to call and discuss corrective measures. No obligation.

POWER **DREW** CHEMICALS

E.F.DREW & CO. INC.
15 E. 26th ST., NEW YORK 10, N. Y.
Representatives in all key cities

BOILER WATER TREATMENT
COOLING WATER CONDITIONING



Better plan your speech now for that 1958 Dinner

Ten years can be a mighty short span in the history of a business. *Yours* for example.

When the time comes to address your fellow executives at the "Annual Banquet" in 1958, will there be a decade of outstanding company progress for you to review?

One way to make sure of a prospering business tomorrow is to make certain *today* that your employees are buying U. S. Security Bonds regularly—on the Payroll Savings Plan. The Payroll Savings Plan is a "look-ahead" plan for both management and employees. It builds up an employee group with a sense of extra security...with a tangible stake in the nation's future...a group bound to shun dollar-destroying philosophies. At maturity, the Bonds pay $4 for every $3 invested.

P. S. P. is paying off *today*, for every Security Bond dollar built up in the Treasury retires a dollar of the national debt that is potentially inflationary. Records of the companies that actively maintain the Payroll Savings Plan show improved employee attitudes. Absenteeism and accidents have dropped as the individual's feeling of security grows with regular Bond buying.

The whole plan of action for use within your company has been mapped out. Just call your Treasury Department's State Director, Savings Bond Division.

The Treasury Department acknowledges with appreciation the publication of this message by

POWER GENERATION

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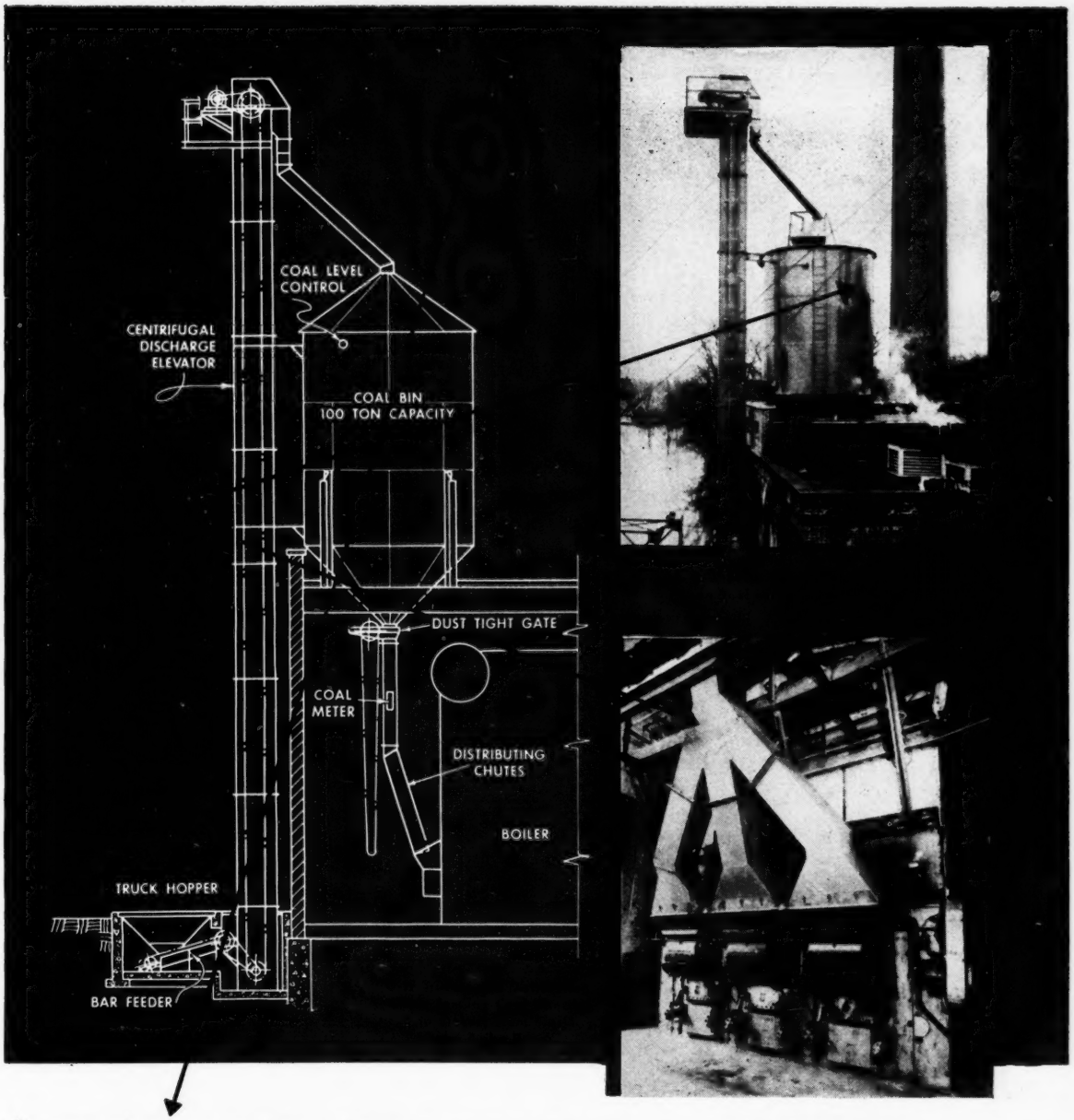

IN THIS CASE tight quarters saved dollars

When Braendly Dye Works, Inc., at Beacon, N. Y., modernized their steam boiler plant, a mechanical coal-handling system was required to replace the old, slow manual method. A G-W engineer was called in . . . recommended the elevator-storage system illustrated.

A river bank restricted ground storage space . . . a disadvantage that G-W ingenuity converted into economies. A live storage, steel bin was designed and mounted on roof directly over boiler room. Coal is supplied to bin by a bucket elevator and fed continuously by gravity directly to stokers. Warm boiler room air surrounds bottom cone of bin . . . prevents coal freezing.

Elevator boot is fed by bar type feeder which permits a truck hopper shallow enough to safeguard against flooding when river is high.

G-W took over *this* complete job . . . from design through construction and erection . . . shouldered all responsibilities. G-W's complete engineering service is yours for the asking.

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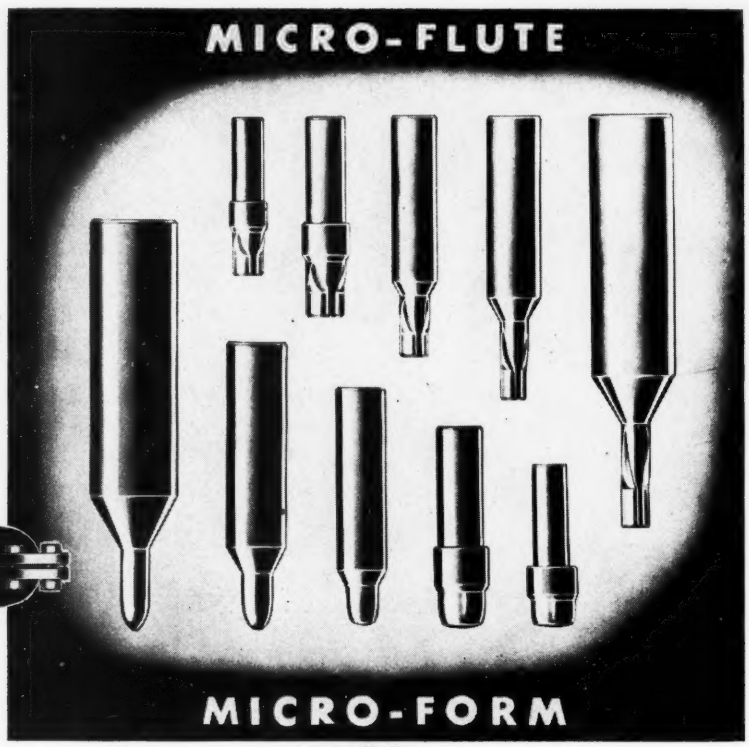
PROPORTIONAL UNIFORM PERCENTAGE

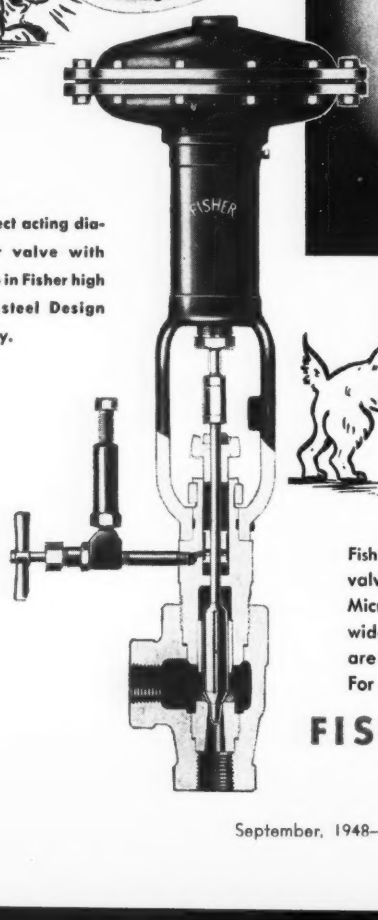
INNER VALVES

RETAINS FLOW CHARACTERISTICS UNDER HIGH PRESSURE DROPS

40 TO 1 RANGEABILITY

2 YEARS OLD AND GOING STRONG





Type 57DA direct acting diaphragm motor valve with Micro-Form Pup in Fisher high pressure cast steel Design "D" angle body.

STAINLESS STEEL OR CAST STELLITE

EQUAL PERCENTAGE FLOW CHARACTERISTICS

Fisher PUP Inner Valves are available in two types, (1) Micro-Flute, an inner valve with a fluted opening having a continuous change in contour, and (2) Micro-Form, an annularly turned valve plunger, accurately formed to fulfill a wide range of flow requirements. Both Micro-Flute and Micro-Form inner valves are available in sizes ¼" to 1", applicable to control valve sizes ½" to 2". For further details send for Bulletin A-100.

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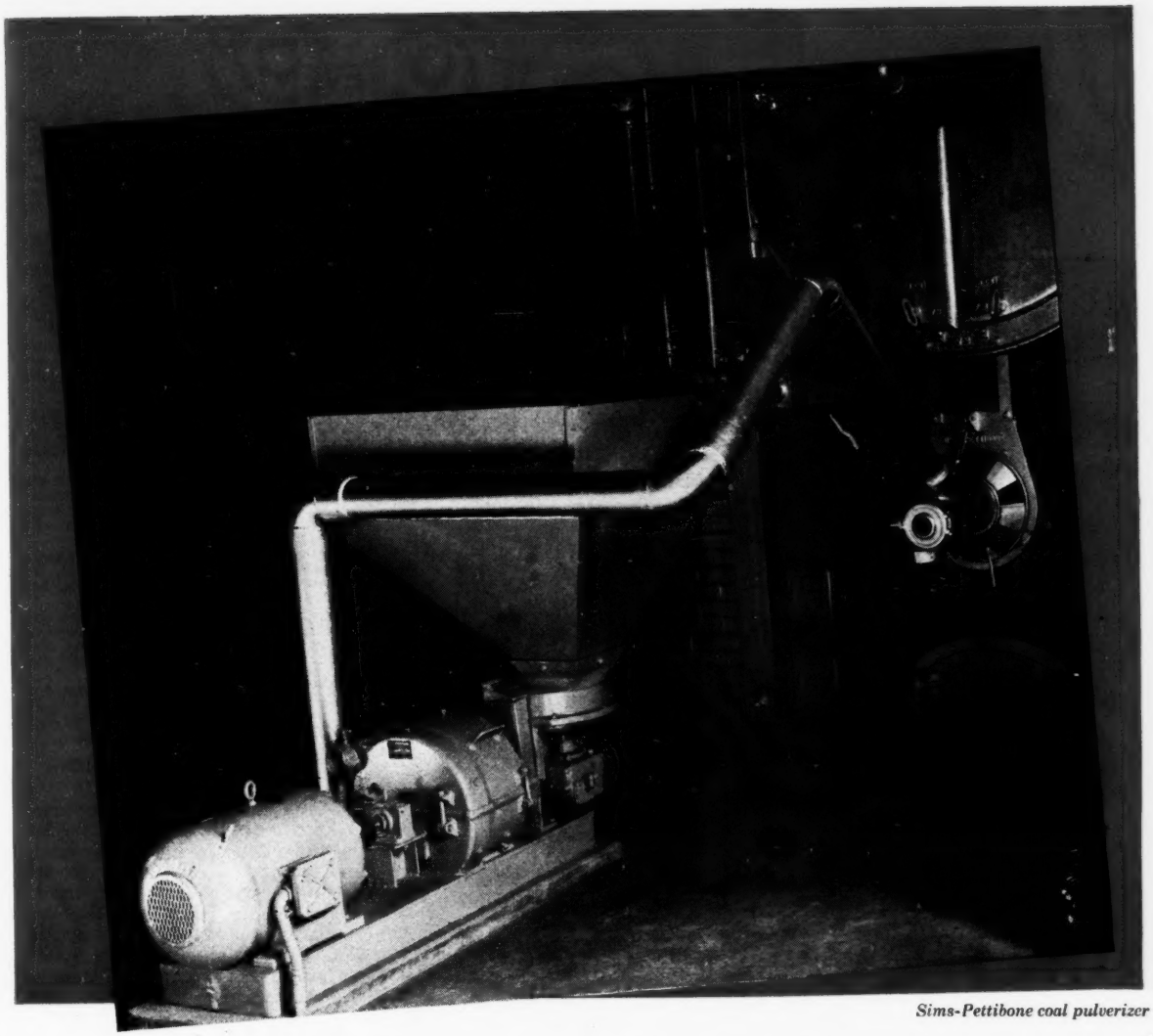

Sims-Pettibone coal pulverizer

The wear that isn't there

WHEN you pump coal through a piping system, you really get friction that can wear out pipe connections in jig time. So—Tube-Turn welding fittings are used in the piping on Sims-Pettibone unit pulverizers for firing furnaces and boilers.

Says Mr. W. W. Pettibone: "*Some of these jobs have been in use for over ten years, yet the Tube-Turn welding fittings have withstood the wear of pulverized coal very well. . . . Very few have been replaced in less than ten years' service. . . . Prior to adopting Tube-Turn welding fittings, we welded small sections of pipe . . . giving us a sort of stove bend. . . . They were expensive to make and offered much more friction.*"

The strength, leakproof permanence and smooth flow made possible with Tube-Turn welding fittings spell long life and safety for any kind of power piping. Tube-Turn welding fittings are manufactured in a wide range of types, sizes, metals and alloys, to meet any power piping problem.

Your nearby Tube Turns distributor carries a large stock. For good service in good connections, specify "Tube-Turn".

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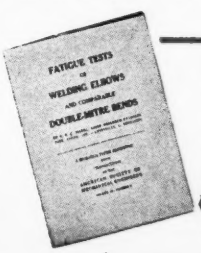
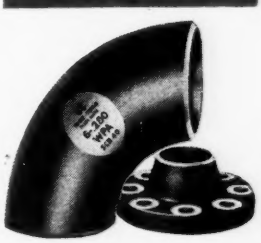
WELDING FITTINGS AND FLANGES



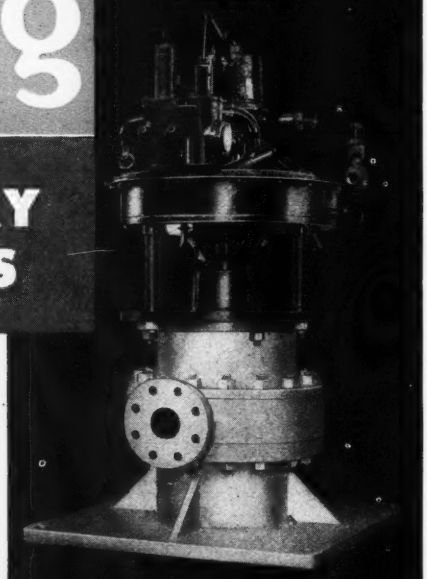
Write for copy of research paper presented before A.S.M.E. — "Fatigue Tests of Welding Elbows and Comparable Double-Mitre Bends".



Wing

AUXILIARY TURBINES

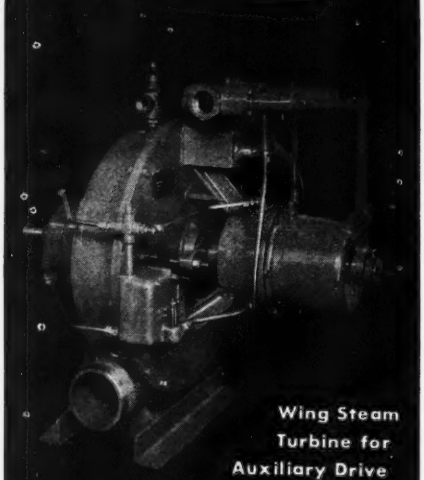
Wing All-Steel Welded Vertical Turbine for Pump Drive



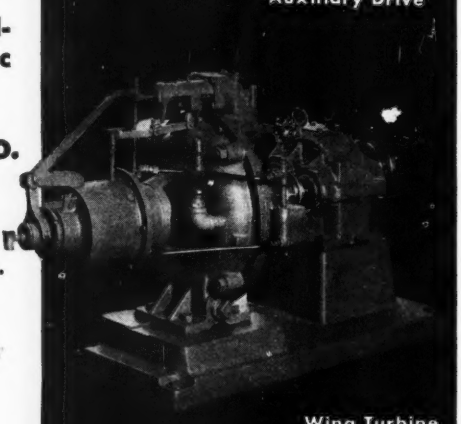
Wing Steam Turbines have been a dependable source of power in industrial and marine applications for over a third of a century. During that time these sturdy, dependable prime movers have been giving satisfactory service in thousands of industrial and marine installations under the most exacting conditions of service.

Wing turbines today are available for pressures up to 600 psi. and temperatures up to 750° F.

Write for turbine bulletin or for specific details.



Wing Steam Turbine for Auxiliary Drive



Wing Turbine and Gear Combination on common pedestal base

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COMING EVENTS

Instrument Society—Instrument Society of America annual meeting to be held in Convention Hall, Philadelphia, September 12-17.

AISE—Iron and Steel Exposition and Convention to be held at the Cleveland Public Auditorium, Cleveland, September 28-October 1.

ACS—Fifth National Chemical Exposition of the American Chemical Society to be held at the Chicago Coliseum, Chicago, October 12-16.

ASCE—1948 Fall Meeting of the American Society of Civil Engineers to be held in the Statler Hotel, Boston, October 13-15.

Water Conference—The Ninth Annual Water Conference of the Engineers' Society of Western Pennsylvania will be held in the Hotel Wm. Penn, Pittsburgh, October 18-20.

ASM—Annual Convention of the American Society for Metals to be held at the Benjamin Franklin Hotel, Philadelphia, October 23-29.

AIMME—Annual Fall Meeting of the Institute of Metals Division American Institute of Mining and Metallurgical Engineers to be held at the Hotel Adelphia, Philadelphia, October 25-28.

AWS—Annual Convention of the American Welding Society to be held at the Bellevue-Stratford Hotel, Philadelphia, October 25-29.

ASME—The annual meeting of the American Society of Mechanical Engineers to be held at the Hotel Pennsylvania and New Yorker, New York, November 28-December 3.

Power Show—18th National Exposition of Power and Mechanical Engineering will be held in the Grand Central Palace, New York, November 29 to December 4.

UTILITIES MATERIALS HANDLING

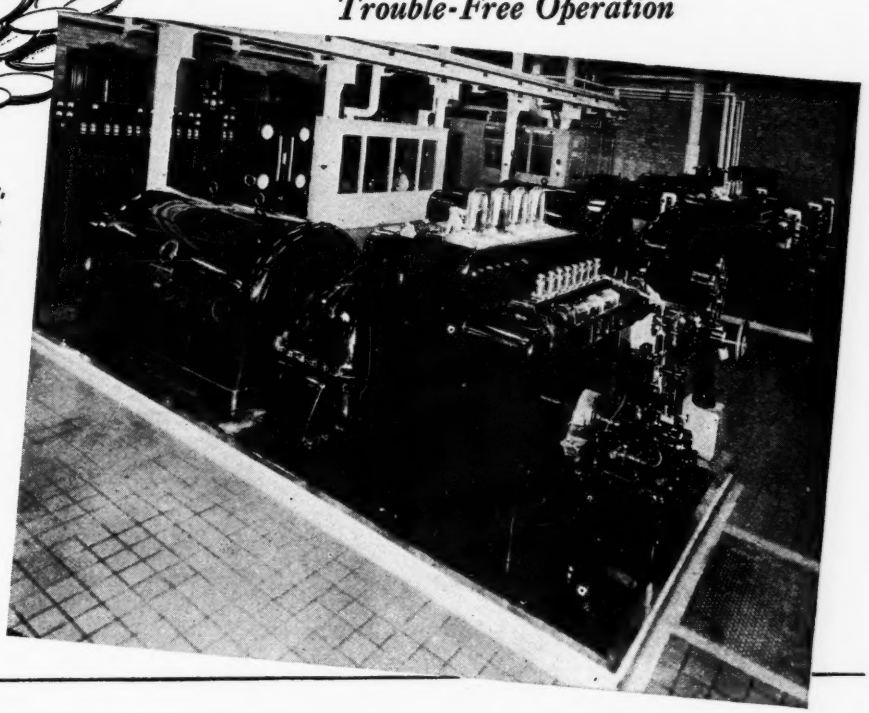
(Continued from page 57)

the day, according to requirements specified on bills of material for the jobs to be done, and are made ready for loading on the trucks in the evening. Four-wheel hand trucks are frequently used in assembling the various items to make up the bills of material. Hardware items, insulators, etc., are handled in original vendor's packages where large quantities are specified. For smaller quantities, steel shop pans are used to transfer the materials from stock to the lineman's truck. Wire is dispensed on the original reel or in coils, as a usual thing. Distribution transformers may be stored on four-wheel dollies, and loaded onto the truck by an overhead hoist or crane.

Most of the warehouses have truck-level docks on which much of the materials are stored. The trucks are backed up against the docks, inside the warehouse building, for night storage. The materials are loaded on to the trucks while in this position, overhead traveling cranes being used when necessary. Vendor's deliveries made either by common carriers' truck or by rail freight may easily be unloaded at this dock level. In this work roller type gravity conveyors or power driven portable belt conveyors may be found helpful. This field has not as yet been entirely explored. We have found the power driven hand lift fork trucks to be very useful in moving either skid platforms or pallets between the truck loading dock and the storage piles.

COST-CUTTERS YOU CAN DEPEND ON!

Worthington Turbine-Generators Set The Pace For Economical, Trouble-Free Operation



Two Worthington 2500 kw, 3600 rpm, 13,800 volt, 3-phase, 60 cycle Turbine-Generator Units at the Kaiser-Frazer plant in Willow Run, Michigan. They operate on steam at 250 lb. initial pressure, 470° F. total temperature, and exhaust at 27½" vacuum. Steam is automatically extracted at pressures from 15-50 lb. Installed in 1941, these Worthington Units supply both electric power and extracted steam for plant heating.

Worthington builds Turbine-Generator Sets in sizes up to 7500 kw, and in all types—including straight condensing, straight non-condensing, extraction, mixed pressure, mixed pressure extraction, low pressure and high back pressure.

Throughout industry these units are generating lower cost power, requiring only minimum maintenance, chalking up records of 99% — and better—for continuous operation, year after year.

IN YOUR OWN PLANT

Worthington engineers will be glad to study your power requirements, and to give you an estimate of the savings possible with the Worthington Unit that best meets your particular needs.

For further details proving *there's more worth in Worthington*, call your nearest Worthington District Office, or write to *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.*

WORTHINGTON

STEAM TURBINES

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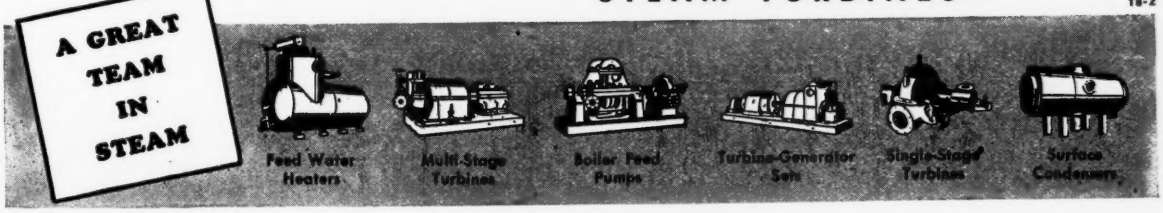

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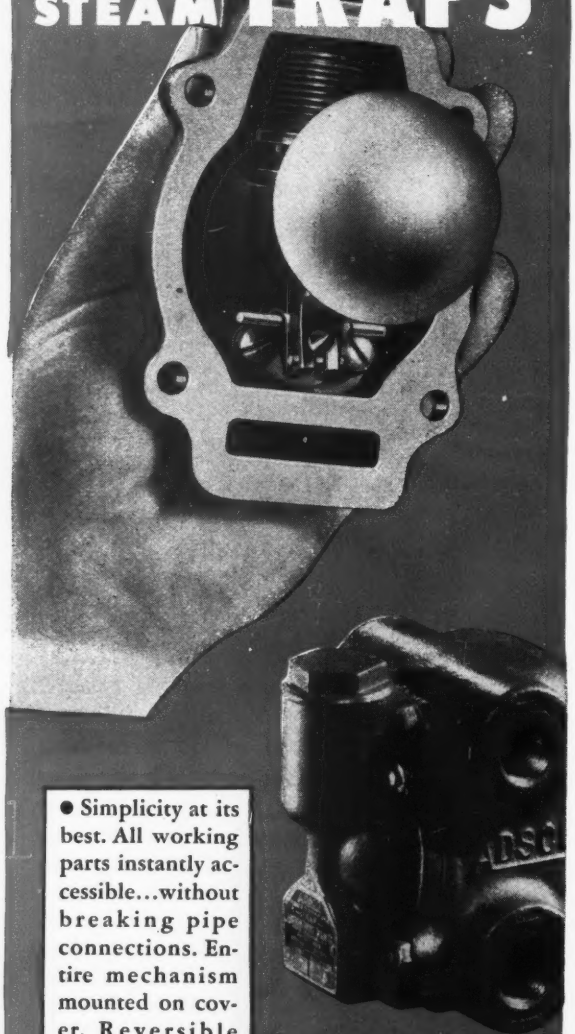

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Steam and Gas Engineering. By Thomas E. Butterfield, Burgess H. Jennings and Alexander W. Luce; Fourth Edition; 588 pages, illustrated; size 6 by 9 in., cloth binding; published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y. Price $6.00.

The first edition of this book was published in 1929 and was intended to give the latest facts and best procedures in elementary steam and gas engineering. The present fourth edition is in the main rewritten, completely reset and newly illustrated.

The principal emphasis of the book remains on steam engineering. The data on steam turbines are expanded while the presentation of reciprocating engines has been further condensed. Much new material has been added in steam generating and combustion equipment and the discussion of power plant cycles has been extended. Discussion of gas properties and gas cycles is now a larger part of the text, with a different approach and more examples. Refrigeration treatment has been increased and is now associated with about an equal amount on air compressors and compression.

Introduction of a chapter on the turbo-jet, the turbo-supercharger and other applications of the gas turbine emphasizes the increasing importance of that equipment.

The book begins with a chapter on progress in the power engineering field, then discusses energy and laws of thermodynamics. This is followed by detailed treatment of the steam engine, properties of steam, steam cycles, and thermodynamics, testing and performance of steam engines. Chapter 7 deals with fuels and power and then some chapters on principles of combustion, combustion calculation and details of combustion equipment. Boiler plant auxiliary apparatus has been discussed briefly. This is followed by chapters on steam turbine types and performance, turbine nozzle and blading calculations, steam power plant cycles and heat balance. Gas properties and gas cycles are treated in enlarged chapters and the book concludes with a discussion of internal combustion engines, the gas turbine and compression and refrigeration. Steam tables and a working size Mollier Diagram are included.

Elements of Applied Energy, by Frederick T. Morse; First Edition; 444 pages, illustrated; size 6 by 9 in., cloth binding; published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y. Price $5.50.

This book, says the author, is the outgrowth of years of frustration when he sought repeatedly and with indifferent success, to implant a sound knowledge of thermodynamics and heat power in the minds of many an embryo engineer, beginning usually at the second-year level.

The book is designed to acquaint the reader with the nature and inter-relation of the various forms of energy, then show him the how and why of machines and other equipment in which energy plays a part. It is designed primarily for those who must take only a single course in heat-power engineering and are pursuing lines of study only casually involved with heat engines.

It begins with a discussion of the structure of matter and of temperature, pressure and volume, leading into a non-mathematical discussion of thermodynamics and gas laws, and of thermodynamic properties such as specific heat and entropy. With this preparation, the reader is introduced to fuels and combustion, heat work transformation and the mechanical elements and details of heat engines and their auxiliaries. There are good chapters on the gas turbine and jet propulsion, on steam engines and turbines and their auxiliaries, and the book concludes with a discussion of feedwater conditioning, combustion control, water pumps and other auxiliaries.

The illustrations are up-to-date, showing modern equipment and methods. A supplement in a pocket on the back cover gives steam tables, thermodynamic properties of commonly used fluids, Mollier program.

Report on Oil-Engine Power Cost for 1946; 40 pages, 8½ by 11 in., paper binding; published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

Like its predecessors, this report gives information on performance and production costs of oil-engine power plants.

In the Report for 1945, only 112 plants were covered because wartime conditions and postwar readjustments had restricted the number of plants that found it possible to co-operate. The trend is now reversed and there is a substantial increase in the number of plants reporting their data, so that in the current report 126 plants are covered.

Moreover, this upward trend in the number of plants reporting indicates a recognition by Diesel plant operators of the value to them of these reports, to the extent that they are again expending the time and effort necessary to submit the required data.

Thermodynamics, by Lester C. Lichty; second edition, 1948; 340 pages, 160 illustrations; size 6 by 9 in., cloth binding; published by the McGraw-Hill Book Co., 330 W. 42nd Street, New York, N. Y. Price $4.50.

In the first edition of this book, it was pointed out that thermodynamics has so baffled the average student that it has acquired the undesirable reputation of being too difficult for any but the the most gifted. The book was originally written to simplify the treatment and eliminate many of the mathematical manipulations.

To accomplish this the author consolidated the treatment into logical groupings from the standpoint of thermodynamic analysis rather than mechanical equipment. He also attempted to establish a better balance between vapor and combustion processes.

In the second edition, the same general arrangement has been retained, since it proved effective in the first, but much of the text has been rewritten to clarify the more difficult parts. The chapter on properties of mediums and processes has been divided into two, and a section on non-steady flow processes has been added. Also, a section on gas turbine is now included.

The author is professor of mechanical engineering at Yale University.

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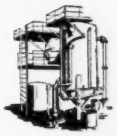

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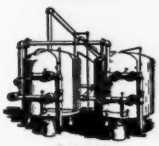

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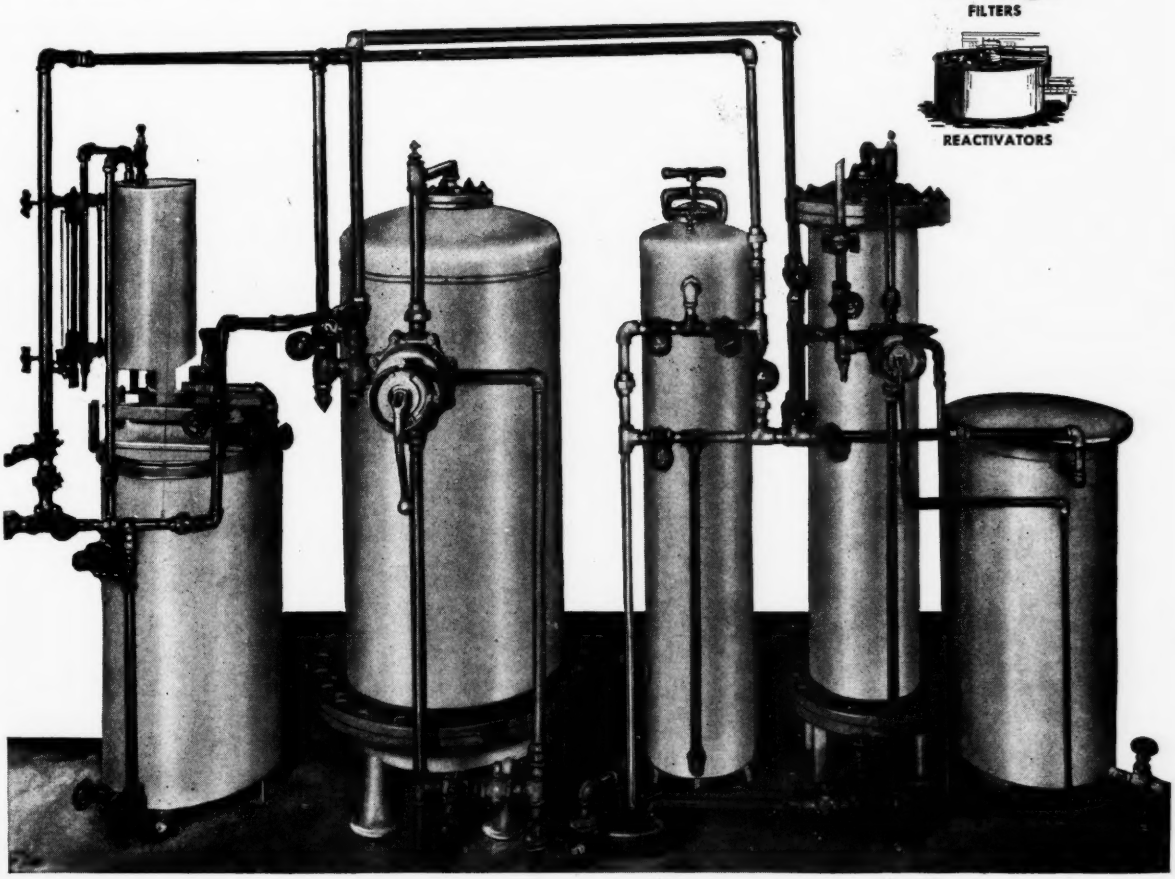
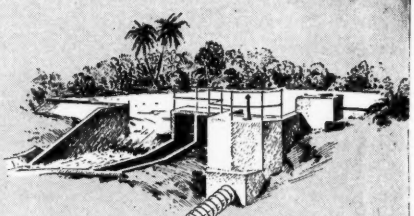
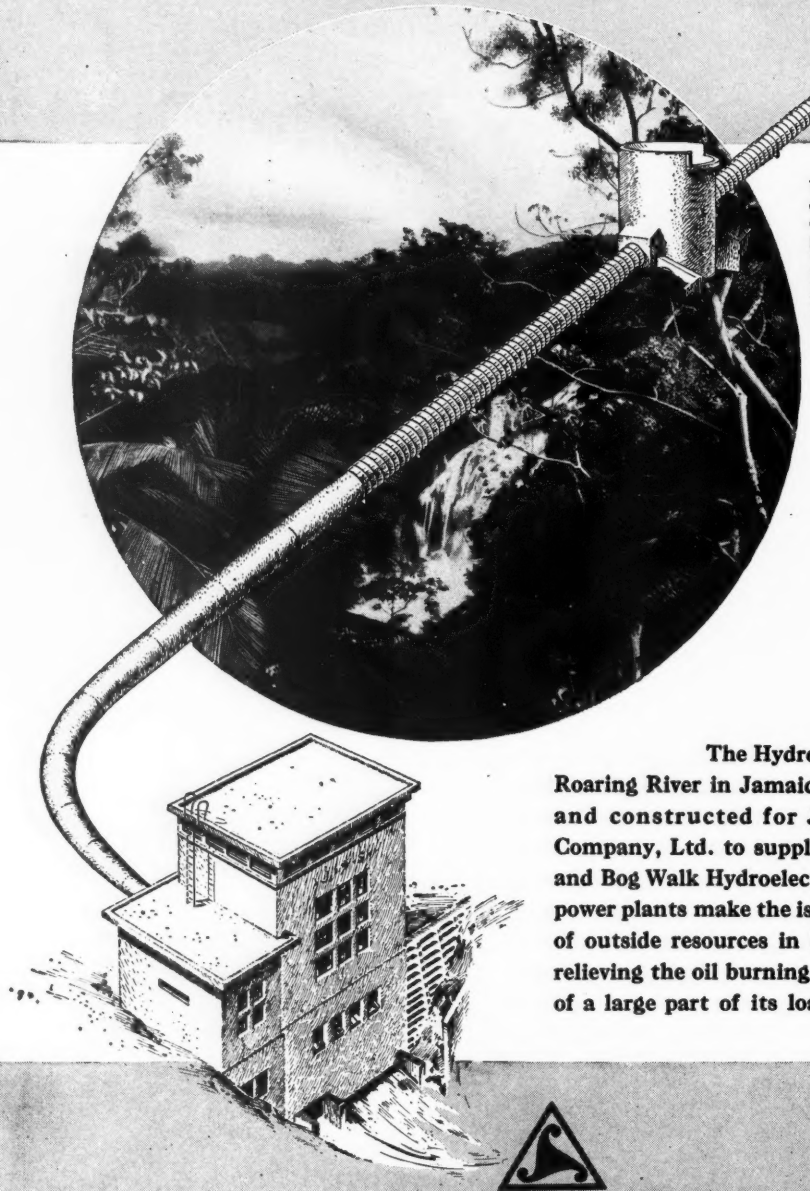


THE HARNESSING OF ROARING RIVER...





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The Hydroelectric Development on Roaring River in Jamaica, B. W. I. was designed and constructed for Jamaica Public Service Company, Ltd. to supplement their White River and Bog Walk Hydroelectric Plants. These hydro-power plants make the island largely independent of outside resources in its production of power, relieving the oil burning power plant in Kingston of a large part of its load.

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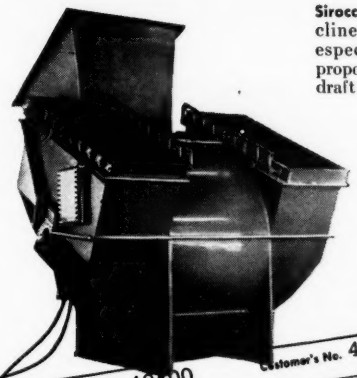
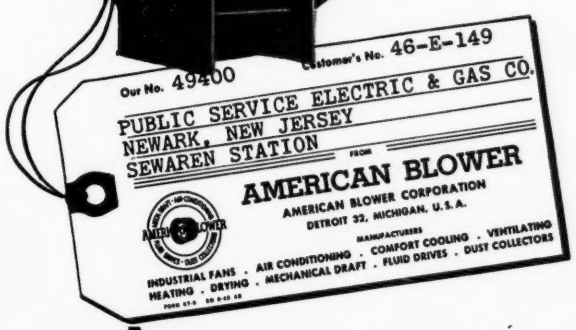


Sirocco Fans, forward inclined blade type, are especially designed and proportioned for induced draft duty.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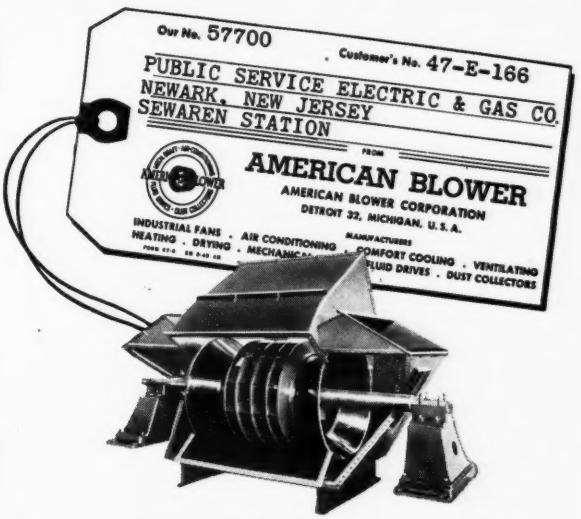
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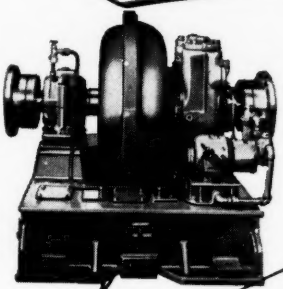
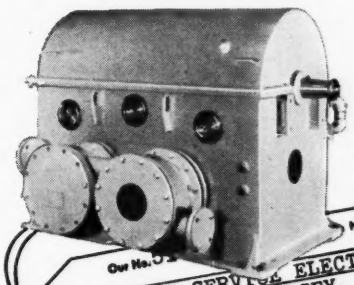
American HS forced draft fans, backward inclined blade type, are particularly suited to forced draft applications.



Type PE Gýrol Fluid Drive—for adjustable speed control of forced and induced draft fans.



Type VS Class 6 Gýrol Fluid Drive—for adjustable speed control of boiler feed pumps.

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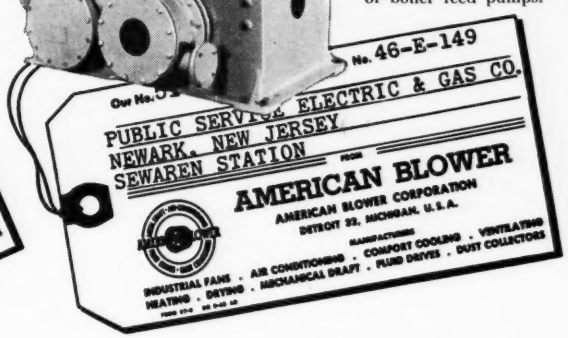
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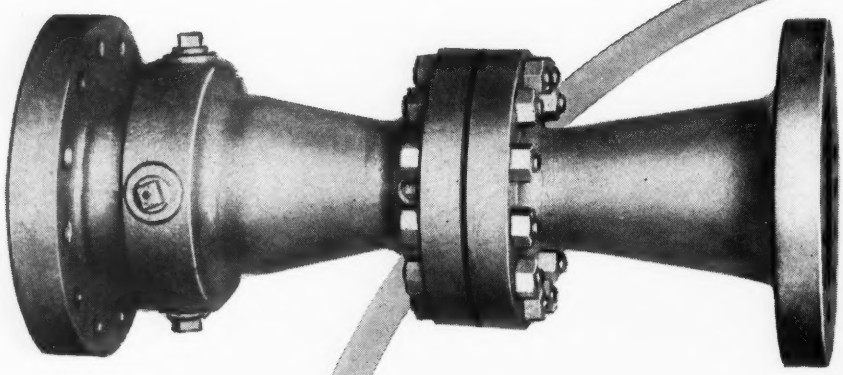

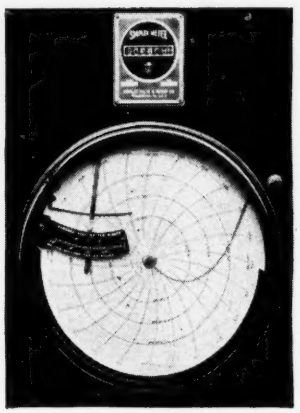

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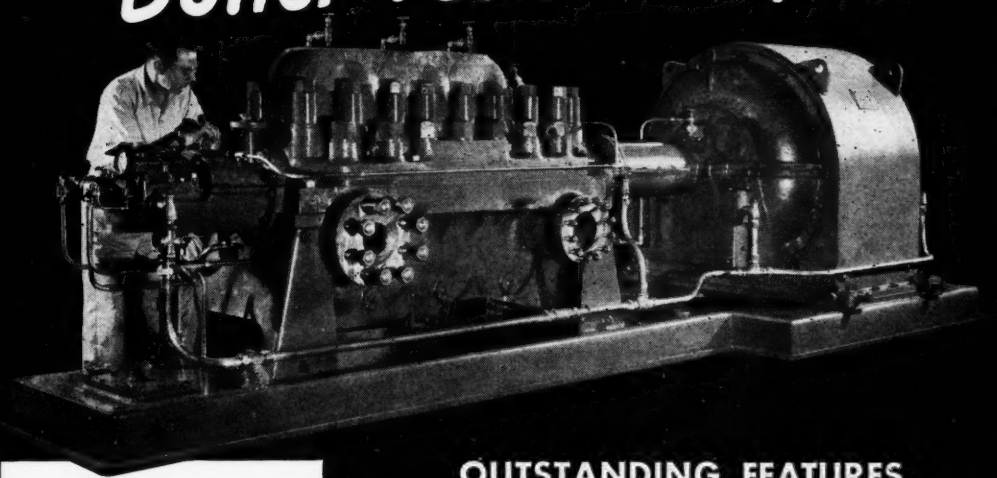

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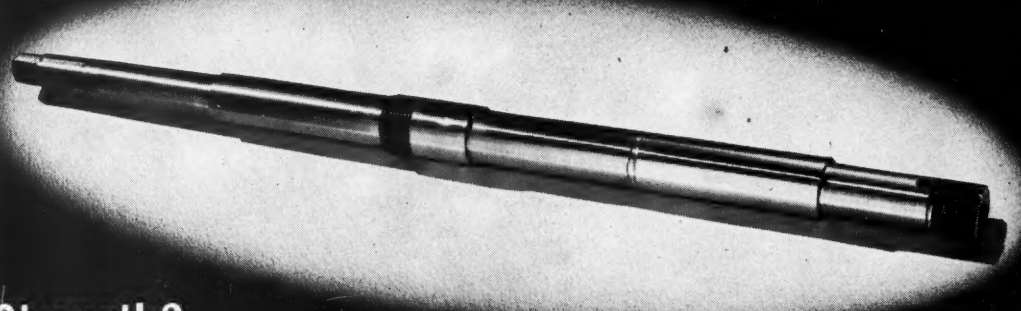

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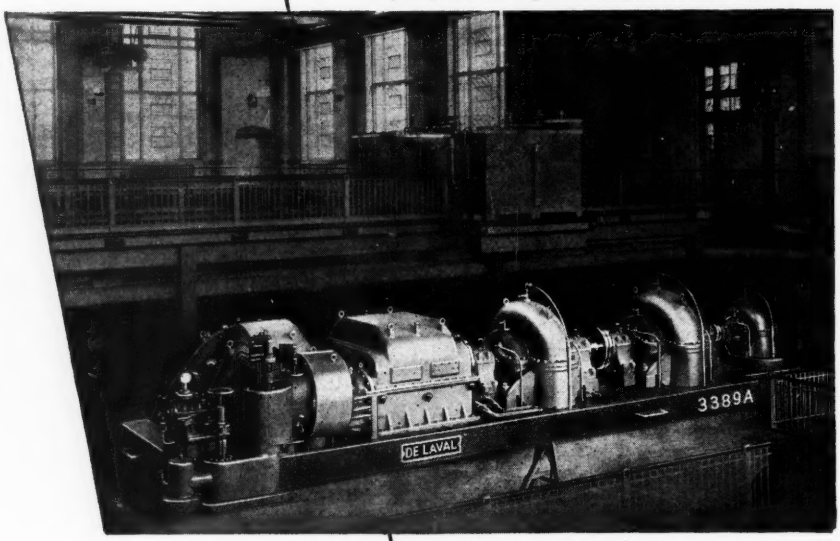

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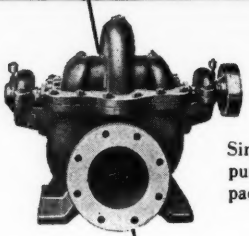

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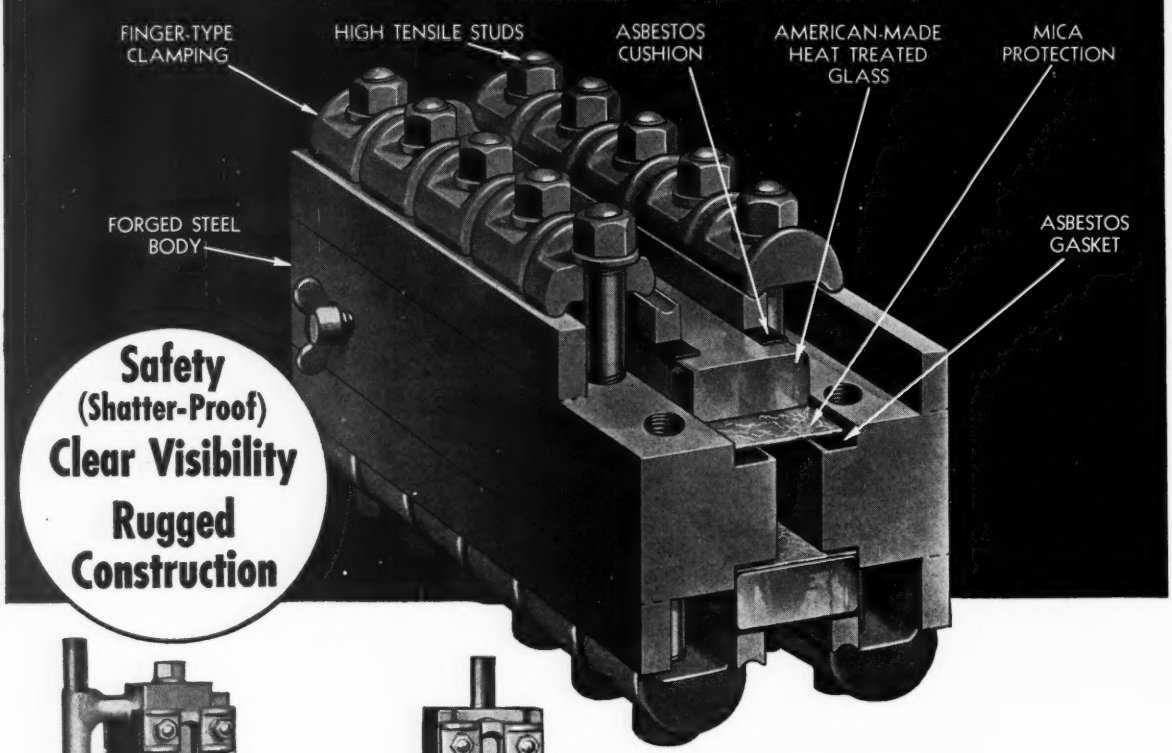
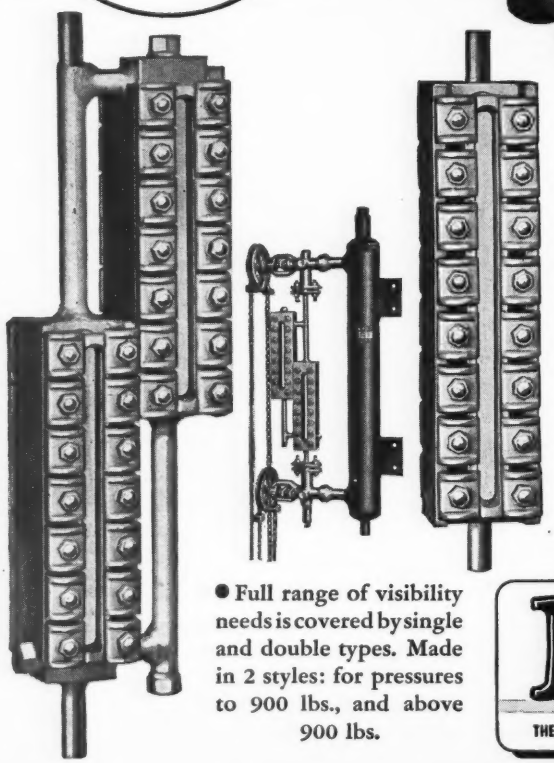
Cut your water gage maintenance with

RELIANCE *Mica-Protected* FLAT GLASS INSERTS



Safety (Shatter-Proof)
Clear Visibility
Rugged Construction



● Full range of visibility needs is covered by single and double types. Made in 2 styles: for pressures to 900 lbs., and above 900 lbs.

Both from the standpoint that the water gages on your boilers are a vital control point *and also constitute a danger point,* you need the sturdiest gage glasses obtainable. And you need clear visibility for mistake-proof reading.

Reliance Flat Glass Water Gage Inserts are rugged assemblies of finest quality heat treated glass—a special composition which resists temperature shock—in heavy steel housings. Sheet mica (see sectional view) resists the erosive action of steam and water. Window slot ½" wide provides a highly visible gage reading which can be accentuated by using a Reliance Illuminator. Can be installed in any gage valves. Write for complete information.

BOILER SAFETY DEVICES since 1884

Reliance

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Chlorination...

REDUCES CONDENSER "DOWN-TIME"

When high back-pressure due to slime fouling on condenser water-side surfaces results in excessive down-time and costly plug cleaning, the best "doctor" is chlorination. Here's why:

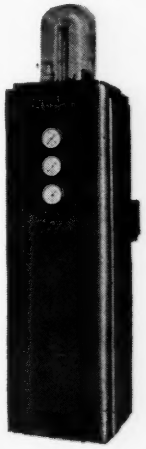
Properly applied chlorination by means of a job-engineered W&T installation is economical. In most cases, the cost of the equipment is saved in the first year.

Chlorination gets at the source of the trouble by killing the micro-organisms that cause slime deposits.

Plug cleaning is eliminated and equipment may be kept on the line thus, in effect increasing station capacity.

Fuel costs are reduced through reduction in average back-pressure.

W&T's more than thirty years' experience in water treatment are always at your call. Write today for a survey of your cooling water system—there's no obligation.



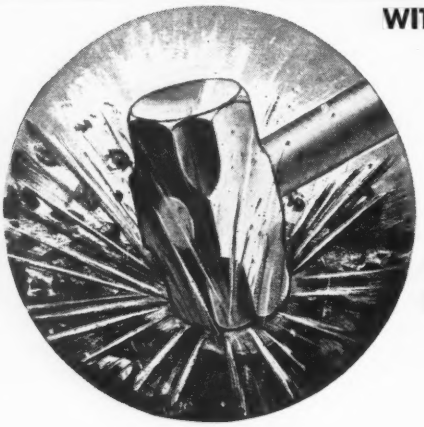
WALLACE & TIERNAN
PRODUCTS, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
Belleville 9, New Jersey • Represented in Principal Cities

CD-29

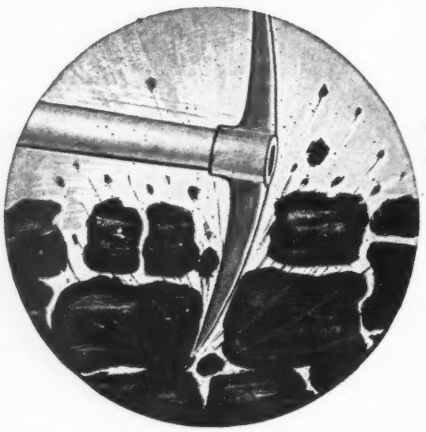
Better Coal Preparation for Greater Combustion Efficiency

WITH

AMERICAN SHREDDER RING CRUSHERS



= RAGGED FIRE BED
EXCESSIVE CO_2
ASH PIT LOSS

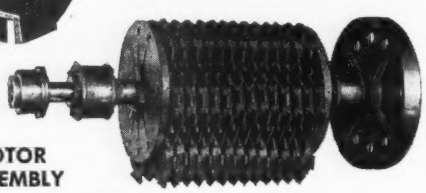


= EVEN FIRE BED
UNIFORM COMBUSTION

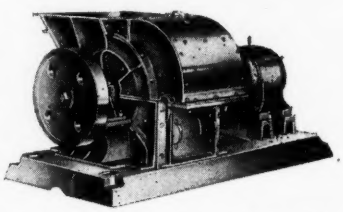
Every pound of coal means *more* BTU's—more efficient heat, when Americans do the preparation job! ROM coal is reduced rapidly with exacting control of fines, uniform sizing and no oversize—at a cost of less than 1¢ a ton. The result: Americans pave the way for a loose, uniform firebed quickly responsive to sudden steam demands—without excessive ashpit drop or unnecessary CO_2.

SHREDDER RING

Patented manganese steel shredder rings, exclusive with American Rolling Ring Crushers, *split the coal* by impact rather than by crushing. Shown below is the rotor assembly, with its many rows of shredder rings. Each ring has twenty cutting edges—and revolves on individual shaft, free to deflect from tramp iron without damage.



ROTOR ASSEMBLY



American Type "S" Rolling Ring Crusher, with heavy cast steel housing, and sectional construction, secured at dust-tight machined joints with coupling bolts for easy access to crushing chamber.

Write for details on efficiency of coal preparation in power plants with American Crushers.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

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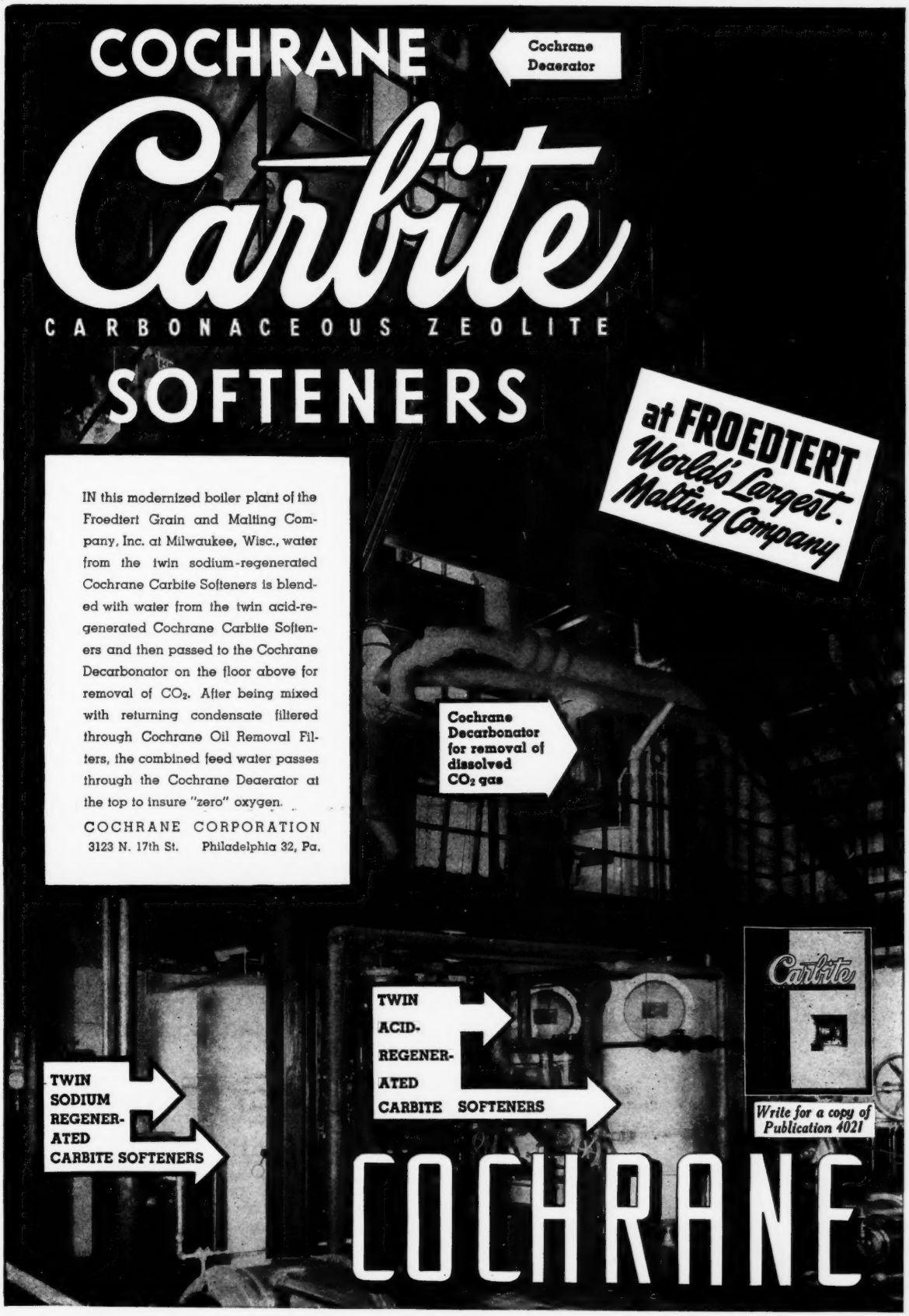
ST. LOUIS 10, MO.


COCHRANE
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CARBONACEOUS ZEOLITE
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at FROEDTERT
World's Largest Malting Company
IN this modernized boiler plant of the Froedtert Grain and Malting Company, Inc. at Milwaukee, Wisc., water from the twin sodium-regenerated Cochrane Carbite Softeners is blended with water from the twin acid-regenerated Cochrane Carbite Softeners and then passed to the Cochrane Decarbonator on the floor above for removal of CO_2. After being mixed with returning condensate filtered through Cochrane Oil Removal Filters, the combined feed water passes through the Cochrane Deaerator at the top to insure "zero" oxygen.
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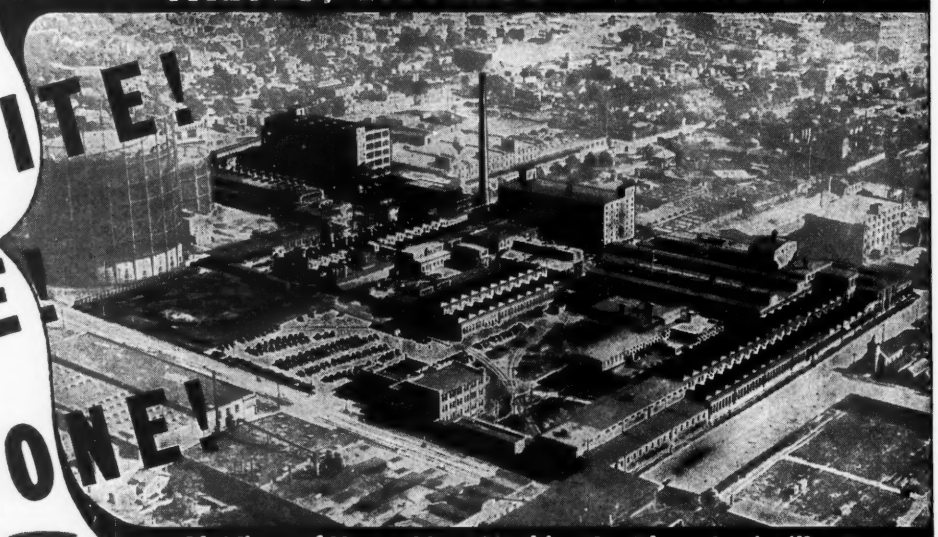

Air View of Henry Vogt Machine Co. Plant, Louisville, Ky.

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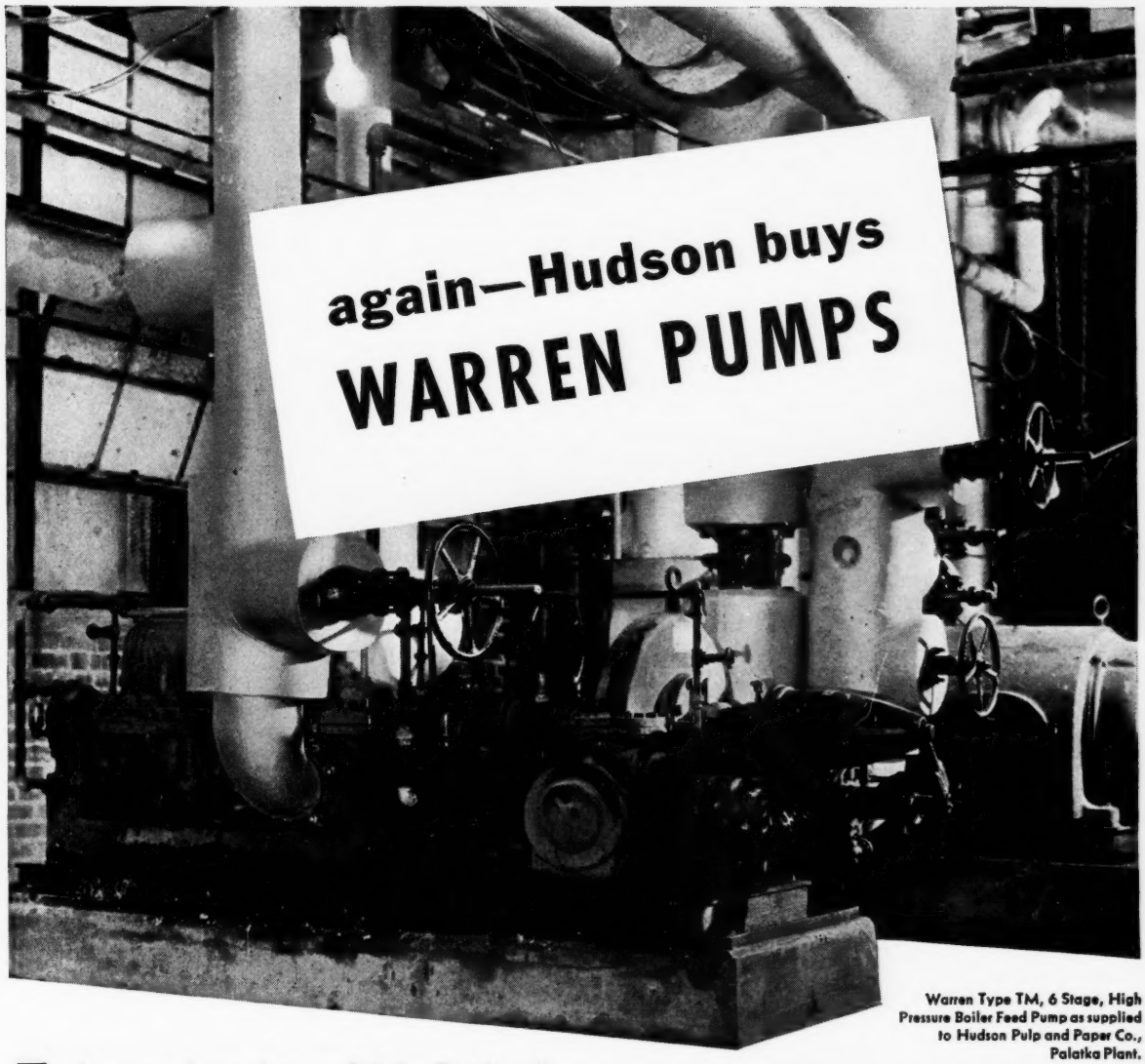


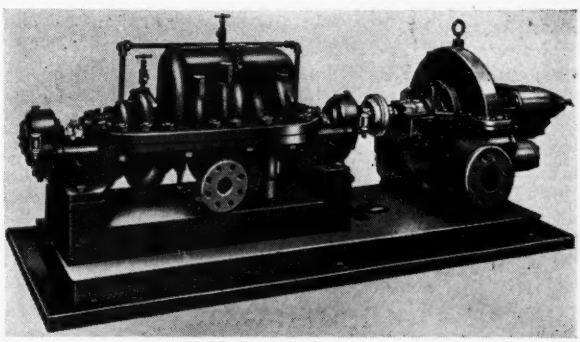
Warren Type TM, 6 Stage, High Pressure Boiler Feed Pump as supplied to Hudson Pulp and Paper Co., Palatka Plant.

For the power plant in their new Palatka, Florida, mill, Hudson Pulp and Paper Company chose Warren Six Stage, High Pressure Boiler Feed Pumps; also Warren Condensate Pumps. Furthermore, Warren Pumps are performing important services in several other Hudson plants.

Warren Pumps are their own best salesmen. They bring repeat business by dependable, low-cost, on-the-job performance.

Warren makes a superior pump for *all* power and various process services. There is a Warren Representative near *you*. Let us send him to discuss your next pumping problem.

P-16



WARREN STEAM PUMP COMPANY, INC. SERVICE EVERYWHERE **WARREN, MASS.**

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CENTRIFUGAL AND RECIPROCATING

For: Power Plants — Chemical Plants — Paper Mills — Food Industries — Metal Working — Oil and Mining Services

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1. **Ash Pit and Cinder-Catching Linings**—Heat-Resistant LUMNITE concrete withstands wear and corrosion in both wet-type and dry-type units.
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6. **Castable Refractories, made with** LUMNITE —used for jointless walls and arches, baffles, burner blocks, door linings, stoker settings and general refractory purposes.
7. **Overnight Structural Concrete**—For rapid maintenance, LUMNITE provides full-strength concrete in 24 hours or less, even in freezing weather.

WAYS TO REDUCE OUTAGES AND CUT MAINTENANCE COSTS

Ready-to-Use
CASTABLE REFRACTORIES

Castable Refractories are factory-prepared mixtures of LUMNITE and selected aggregates. They are mixed with water on the job and cast into place for door linings, arches, baffles or furnace walls. Special shapes can be cast in molds, ready for use within 24 hours.

Castables to meet different temperature and insulation needs are made by refractory manufacturers and sold by their distributors.

Specify Castables
MADE WITH LUMNITE

Coal Bunker lined with Corrosion-Resistant Concrete. Steel or concrete bunkers, bins and silos can be protected from abrasive wear and corrosive attack with LUMNITE linings—cast-in-place, plastered or applied with a cement gun.

Write today for information on the many uses of LUMNITE in power plants.

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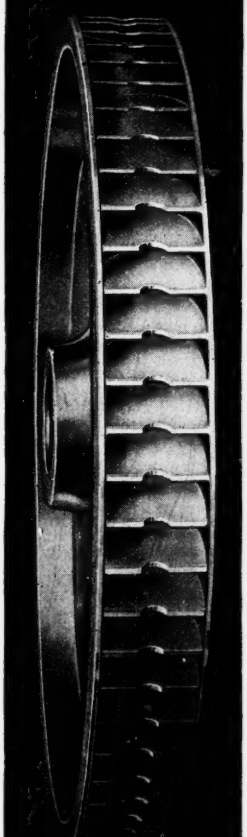

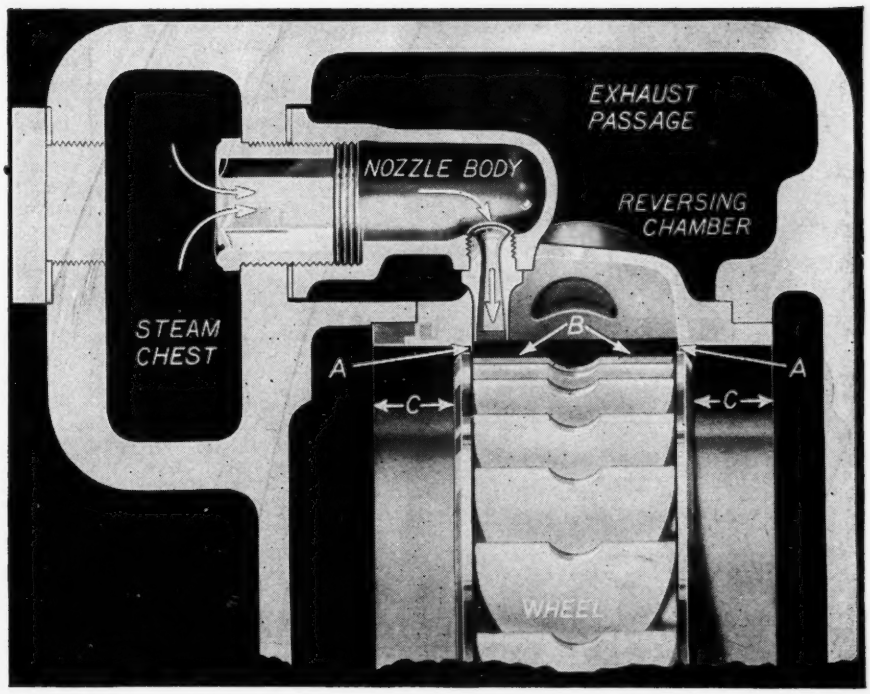

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Large blade and rim clearances and extra large side clearance — one inch — help make Terry One-piece Wheel Turbines highly dependable in operation.

The blades cannot foul because of the protection afforded by the rims, which are not damaged, should rubbing occur.

Note the rim clearance, AA in diagram. Also the large blade clearance, B. Side clearance, CC, is so large that end-play from external thrust cannot damage wheel.

Terry Bulletin S-116 will give you full information on the Terry Wheel Turbine. A request on your business letterhead will bring you a copy.

T-1171

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

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E. M. DART MANUFACTURING CO.
PROVIDENCE 5, RHODE ISLAND

DART
UNIONS

CHEMICAL FEED SYSTEMS

(Continued from page 63)

pump is constant for any potentiometer setting, regardless of load, and since the quantity of liquid pumped by any positive-displacement pump is proportional to the speed of the pump, accurate proportioning of chemical feed to the water flow is achieved with immediate compensation for changes in rate of flow possible.

This system has been applied in a number of instances requiring considerable accuracy, such as proportioning of lime and soda ash in the lime and soda ash softening process. The system can be applied quite readily in the treatment of large quantities of water, such as once-through cooling supplies that vary in flow, and where a suitable mixing tank or reservoir is not available. Typical examples of application of Thymotrol proportioning consist in the addition of acids or alkalies in the adjustment of the pH value of a treated water, stabilizing agents for prevention of scale in heat exchange units and similar equipment.

As in the case of other meter-controlled systems, Thymotrol requires a meter and all incidental equipment for each boiler, so as to provide proportional feed in accord with feedwater demands of the individual unit. Also, variations in make-up characteristics and percentage of condensate would nullify the benefits of proportional feed to some extent, insofar as boiler feedwater treatment application is concerned.

A typical application of electronic proportioning is shown in Fig. 1, involving the use of a pump whose length of stroke, in addition to speed, can be automatically regulated. This system is of especial value in pH adjustment of water with acid or alkali, the speed of the pump being controlled by the Thymotrol unit directly in proportion to the rate of flow of water, as before. The length of stroke is adjusted by a small, reversible motor. On the other end of the control motor is mounted a speed reducer and a potentiometer that is balanced with a potentiometer in the controller circuit. A rectifier gives dynamic braking to prevent coasting past a control point. This further refinement prevents "hunting," which can develop with large variations in water flow when the pump control system is based upon variations in pH of the treated water.

Hydraulic Type Feeders:—Figure 2 illustrates an economical and effective feed system frequently utilized by small municipalities and industrial plants for chlorination and ammoniation of water supplies, pH adjustment, sterilization of sewage treatment plant effluent and similar applications. The system may be used for the proportional feed of

"Water Treatment? .... for this?"

THE BIRD-ARCHER 8-POINT WATER TREATMENT SERVICE

All or any part of this service is available to you

1. *Study of all available water sources*
2. *Plant survey*
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5. *Instructing plant staff in the operation and control of the treatment system*
6. *Furnishing properly prepared treatment materials*
7. *Specifying any equipment necessary*
8. *Regular check-ups by service engineers*

BA-128

The scissors grinder uses water to help him put an edge on his customer's cutlery . . . and to soak his feet at night. Water Treatment will hardly help him, but . . .

There are other uses to which water is put . . . *important* uses, such as industrial cooling and processing, and for generating power. That's where Bird-Archer Water Treatment *can* help . . . for corrosion and scale can be costly.

A difference in efficiency often means an important difference in operating costs . . . That's where Bird-Archer Service *proves* its value.

The Bird-Archer 8-*point* Service, born of 60 years of experience solving water treatment problems, will sharpen up efficiency, grind down operating costs, and stretch the life of water and steam handling equipment. Ask to have a Bird-Archer representative furnish full details.

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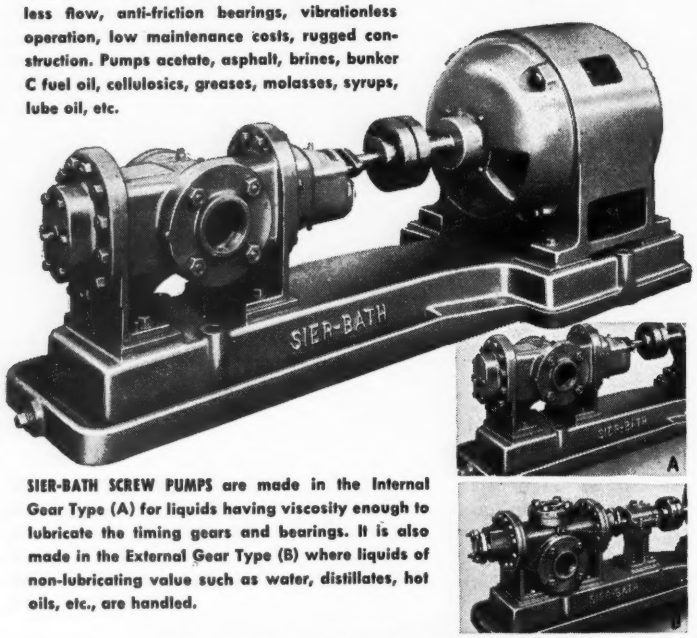
Viscosity means nothing to SIER-BATH SCREW PUMPS

IF you handle fluids so viscous that they are likely to "gum up the works"—it is time for you to look at Sier-Bath Screw Pumps. Nothing beats the thrust of the screw—whether it be the propeller that drives an enormous ship, or the screws in powerful Sier-Bath Screw Pumps.

Having no reciprocating parts, the flow of liquid is continuous . . . no pulsation or fluctuation of pressure, no vibration, no wear-and-tear on pipe joints and connections. Maintenance is reduced to a minimum.

Sier-Bath Screw Pumps can be obtained either in the horizontal model or, where space limitations require, in the vertical model. Send for Bulletin S-3 for complete information.

SIER-BATH SCREW PUMP ADVANTAGES: Pulseless flow, anti-friction bearings, vibrationless operation, low maintenance costs, rugged construction. Pumps acetate, asphalt, brines, bunker C fuel oil, cellulosics, greases, molasses, syrups, lube oil, etc.



SIER-BATH SCREW PUMPS are made in the Internal Gear Type (A) for liquids having viscosity enough to lubricate the timing gears and bearings. It is also made in the External Gear Type (B) where liquids of non-lubricating value such as water, distillates, hot oils, etc., are handled.

ALSO MAKERS OF SIER-BATH PRECISION GEARS

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chemicals to water lines for any purpose, the material used in constructing the reagent head of the pump being selected accordingly.

Most of the standard meters may be adapted as the control medium. The meter does not supply the power to operate the pump but simply controls the inflow of pressure water to the hydraulic cylinder. The design of the pump is such as to permit injection of treating solution into the pressure line. The pump is normally actuated by the pressure of the fluid present in the main line but can be separately actuated by air, steam, oil or water.

The hydraulic system is usually applicable to lines operating at pressures of 100 psi or less. The addition of the pump control mechanism does not affect the meter accuracy to any appreciable degree.

Decanting Type Feeders:—This type of chemical feed system involves the use of a constant-diameter tank fabricated of material suitable for the chemicals to be handled. The tank will be flat-bottomed for handling solutions or will be equipped with a rounded bottom and motor-driven agitator for handling slurries.

The chemical solution is drawn off either at a constant rate, or proportionately, by means of a swing pipe lowered by a cable and drum arrangement, which in turn is controlled by a small fractional-horsepower motor geared to very low speed. Figure 3 shows a feed system of this type equipped with an external draw-off system. This particular type is especially applicable for the feed of corrosive solutions such as acids, alum and ferric salts. By the use of rubber tubing, the contact of the draw-off system with the corrosive liquid is limited to the over-flow box, which is lowered by the control device.

When operating as a constant-rate feeder, the decanting arm is lowered at a constant rate by the control mechanism. This rate is manually adjustable. If proportional feed is desired, a suitable water meter, equipped with an electrical contactor, which makes contact upon passage of a specific quantity of water, is used to control the operation of the lowering motor. A predetermined amount of solution is thereby drawn off for each contact made by the water meter.

The discharge from the decanting arm can be allowed to gravitate to the point of treatment application. Frequently, however, the discharge is introduced to a pump suction box. Several pumping arrangements exist, depending upon the service requirements. In the case of lime and soda ash proportioning, for example, a centrifugal pump is used, which operates continuously, pumping the decanted solution to the point of discharge, with addition of dilution water, as necessary, con-

HERE'S HOW: When your problem is coal . . . switch to oil. When it's oil . . . switch to gas. When it's gas . . . switch back to coal! You can do this *in a matter of minutes* with the *Bros* Steam Generator.

This *Bros*-designed unit is specially built for quick, easy fuel conversion . . . switching from one fuel to another with a minimum loss of working time.

This amazing fuel flexibility has been achieved by *Bros* engineers in steam generating units fired by *Bros Travl-Spred* continuous ash discharge stokers and combination gas and oil burners.

It has given such concerns as the B. F. Nelson Mfg. Co., Minneapolis, control over fuel situations which formerly controlled them. This Steam Generating Unit is one of two 90,000 lb. installations which supply continuous power and process steam for the manufacture of asphalt shingles and other roofing products.

Similarly designed units can free you from the threat of short fuel supply . . . give you fuel flexibility to switch from solid to gas to liquid fuels easily and without loss of time.

For complete details on this *Bros* Steam Generator, write:

WM. BROS BOILER AND MFG. CO.
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Fabricators of Steel *Since 1882*

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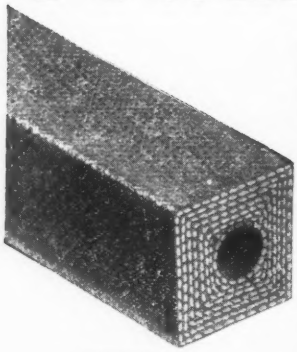
WATER TUBE, FIRE TUBE BOILERS • OVER FEED, UNDER FEED • HYDRAULIC-TRAVL-SPRED STOKERS

MORE POWER TO YOU!



BELMONT 319
Hollow Center Packing

For low and intermediate steam; hot and cold water rods and plungers; steam hammers and elevator plungers.

Philadelphia, Pa. No matter how small — power leaks are costly. That's why Belmont takes such minute care in the construction of all Belmont Packings.

Take Belmont 319, for example. Only the finest quality rubber frictioned duck is used. The hollow center provides a point of least resistance for contraction and expansion. It serves to keep friction at a minimum, since the packing tends to "breathe" towards the "hole" as varying pressures are exerted upon it in the stuffing box.

The construction of Belmont 9 permits the combination of two distinctive materials into one integral packing. The rubber and duck channel acts as a wiper and also a protection to the flax. The linen thread stitching prevents material displacement and buckling so frequently experienced in unstitched packings of this type

BELMONT PACKINGS

Belmont Packings are easy to obtain and convenient to see; distributors are located in every large center, with sample kits displaying Belmont materials and constructions.

Identification is simple. Belmont Packings wherever practicable, are packed in attractive and secure boxes, bearing our orange-colored trade-mark on a blue background.

The Belmont Catalog is available. This invaluable reference book reduces packing facts down to simplest forms. Write on your company letterhead for free copy.

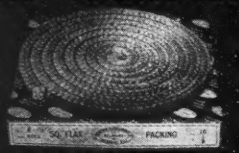
Investigate how Belmont can serve you! Contact your local distributor or write us direct.

BELMONT 9
Special Hydraulic Channel Flax

For all hydraulic services from low pressure to extreme heavy duty, hot and cold water.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia



Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

trolled by a float in the suction box.

A proportional-feed system of this type is sometimes used for adding phosphate and other treating chemicals to boilers, boiler feedlines or other water lines, using an intermittently-operated piston type pump, controlled by a float switch in the suction box. In some cases, a high-capacity chemical pump is employed, discharging to a common header equipped with flow control valves to permit division of flow to a number of discharge points while using only one pump.

The decanting type feeder is used most frequently as a proportioning feeder for lime, soda ash, coagulants, acids and other chemicals applied in the external conditioning of water. A definite advantage is the fact that only one meter and contactor is needed to control the operation of several decanting feed mechanisms. It is not generally applied for addition of phosphates and other chemicals to the boiler systems due primarily to availability of other equipment which is more convenient and less expensive. Also, discharge of phosphates to feedlines is undesirable and proportioning feed of treatment to more than one boiler with one pump and one control meter again introduces the objections outlined in the discussion of systems operating in an essentially similar manner.

Double-Orifice Type Feeders: — The double-orifice type feeder is a solution feeder which normally proportions to within 5 per cent accuracy. Figure 4 illustrates a solution feeder of this type. The principle of operation involves passage of water through the primary orifice A, Fig. 4, creating a pressure differential over the orifice. This difference in pressure causes a flow of water to occur in the piping marked P and P^1, direction of flow indicated. Insertion of a secondary orifice, S, shunts a portion of the water flow through the needle valve Q into the top of the chemical tank. A quantity of chemical solution, equal in volume to the water entering the tank, is ejected, discharging into line P^1 just beyond the secondary orifice. That portion of the water passing through the secondary orifice acts as the dilution water for the concentrated chemical solution. Because of this dilution effect, the densities of the water in column P and the diluted chemical solution in column P^1 are nearly equal, resulting in greater accuracy of proportioning. Since the pressure drop over the orifice is proportional to the flow of water in the line, the amount of chemical solution injected is proportional to the flow.

Chemicals are added to the basket, dissolved in the upper tank and then drained into the lower tank. The density of the chemical solution is

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In installations where bedlam is taboo, Wilson Electrically Driven Equipment gives you tube cleaning on the Q.T. . . . quiet, efficient, trouble free.

And where air, steam or water are not available for tube cleaner operation, Wilson Electric Equipment will do a fast job—no matter what the deposit — even on plugged tubes.

Wilson Electrically Driven Tube Cleaners are easy to handle and operate. They are portable . . . can be taken into steam drums or slung in convenient locations. And they're built for tough service, too. The shafting, for example, is specially wound to resist torque — it won't unravel — there is no distortion.

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TUBE CLEANERS

sufficient to support a special float installed in the gage glass. The float will normally sink in water. Since a definite line of demarcation exists between the water and chemical solution at all times, the float will show the amount of chemical solution present.

Final control over the chemical solution is obtained by adjusting the needle valve. The feeder must usually be recharged at least once daily.

Double-orifice type feeders are frequently applied for the feed of sodium sulfite to boiler feed systems and for the application of various chemicals to once-through cooling water and domestic water systems for the conditioning of these waters for prevention of scale formation, corrosion, and the like. This type of feeder is also frequently employed for proportioning of alum and soda ash ahead of coagulation systems and oil removal systems.

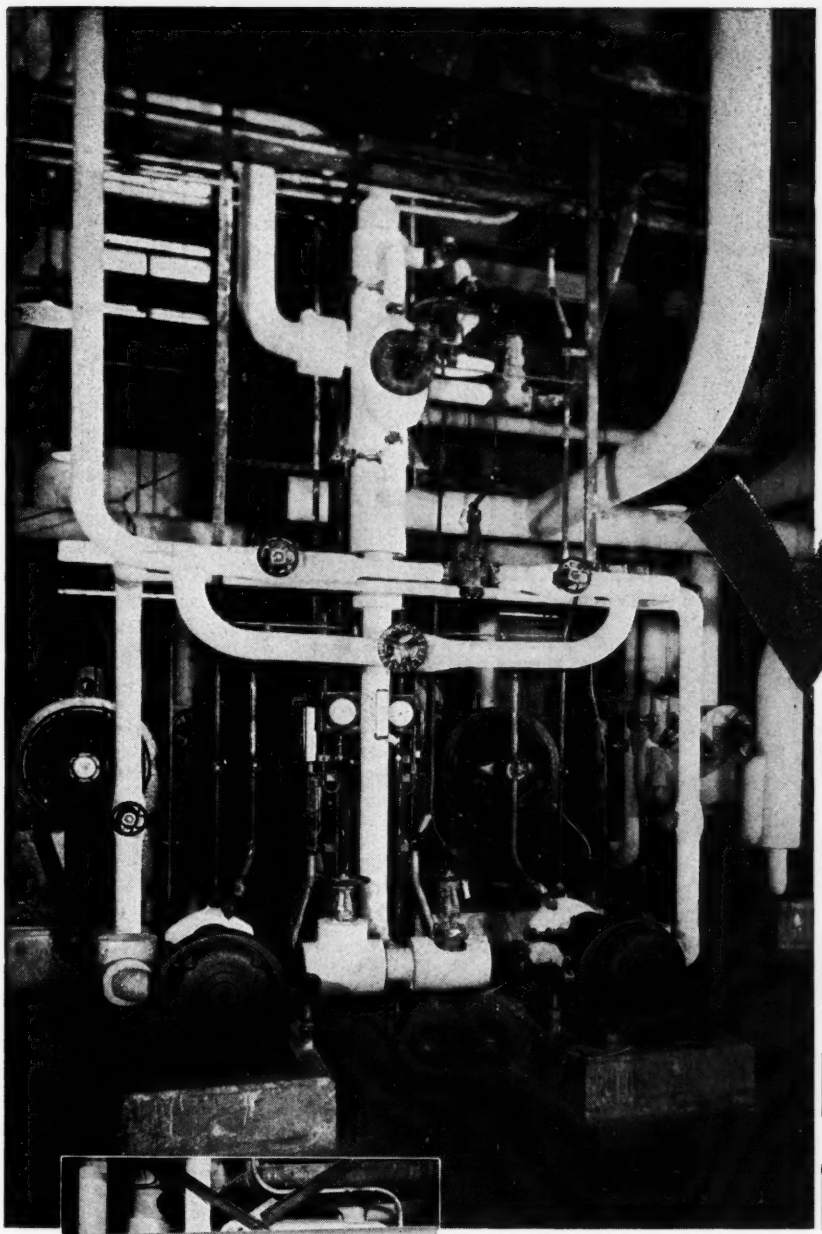
Use of these feeders is generally restricted, in boiler feed systems, by pressure limitations. The feeder manufactured by the average supplier is usually built to operate at pressures not greater than 100 psi. Also, the pressure drop over the primary orifice is sufficient to cause steam binding of the boiler feed pumps if a sufficient static head does not exist between the feedwater heater and the suction of the feed pumps. Application of these feeders for continuous feed of phosphates and other precipitating chemicals to boiler feedlines is not desirable because of the danger of feedline deposits.

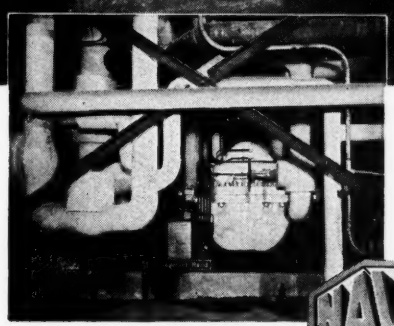
Dry-Type Feeders

Dry-type feeders are generally classified as volumetric type and gravimetric type; and they are usually warranted only in the larger-size plants where the chemical treatment requirements are relatively constant and the quantities of chemicals that must be added to a system exceed approximately 10 lb per hr.

Volumetric Feeders:—One type of volumetric feeder is illustrated by Fig. 5. Chemical is discharged from a hopper onto a circular table, which revolves at a slow and constant rate of speed. One or more multi-section feed knives extend into the drum, deflecting an amount of chemical dependent upon the position of the knives. The feeder can be calibrated for use with any chemical of relatively uniform composition and density. Once calibrated, the number of pounds of chemical that will be delivered per unit of time, for the various settings of the feed knives on the rotating table, will be known.

Chemicals removed from the rotating table are dissolved or suspended in slurry form by introduction to a dissolving pot agitated by a vortex of dissolving water or by a small motor-driven agitator.





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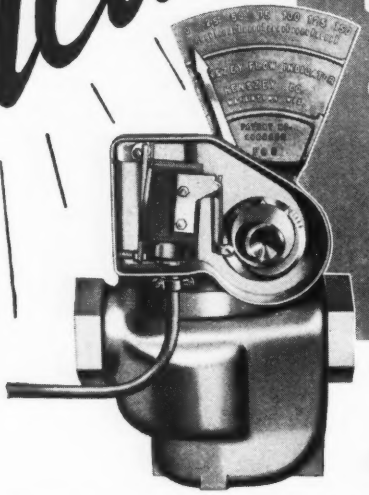

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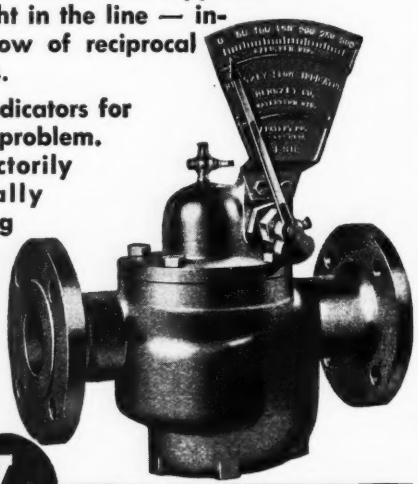

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Still another type of volumetric feeder employs an oscillating plate below the chemical hopper. The length of stroke of the plate and depth of chemical on the plate are both adjustable, in order to obtain varying rates of discharge.

Accuracy of any volumetric type feeder is dependent, to a large extent, on the consistency of the chemical being fed. If the density, or weight of the chemicals per cubic foot, is subject to any great variation, then this same variation will appear in the rate of chemical feed. Certain chemicals tend to "arch" or "hang" in the feed hopper, requiring agitators or vibrators to be installed in the hoppers. Care must then be exercised to prevent packing of the chemical, for this would directly affect the accuracy of proportioning. The normal accuracy is within 5 per cent.

Gravimetric Feeders:—Gravimetric feeders measure the chemical to be fed by weight, resulting in accuracy of proportioning within 1 to 2 per cent. A typical gravimetric feeder is shown in Fig. 6. The chemical is fed to a traveling belt, the amount of chemical admitted being controlled by a gate, which in turn is regulated by the total weight of the belt assembly and chemical. A constant weight of chemicals is maintained on the belt and variation in rate of feed to the treater are obtained by varying the speed of the belt.

There are several variations of this principle, but essentially, gravimetric feeders are scales, balanced in such a manner as to assure the delivery of the desired weight of chemicals to the system. The chemicals discharged by a gravimetric feeder are placed in solution or suspension form, in the same manner as for a volumetric feeder, for introduction to the treating process equipment.

Gravimetric feeders are considerably more expensive than volumetric types, hence are applied only to large systems where the additional accuracy is required or when chemicals are used whose variable density prevents use of volumetric feeders.

References

Betz Handbook of Industrial Water Conditioning; W. H. & L. D. Betz, Philadelphia, Pennsylvania

R. T. Sheen; POWER PLANT ENGINEERING, May 1945, Vol 49, No. 5

R. T. Sheen; 8th Annual Water Conference, Engineers' Society of Western Pennsylvania, November 1947

VARIABLE SPEED DRIVES FOR B-F PUMPS

(Continued from page 69)

by the pump brake horsepower curve.

Comparison of power consumption at the various loads for the 700-hp motor unit is presented in Tables I, II and III. The saving obtained through the use of the variable-speed drive is 195,500 kwhr per year.

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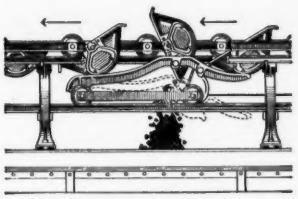
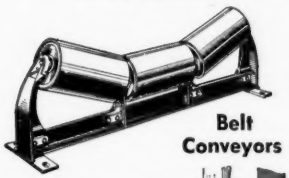
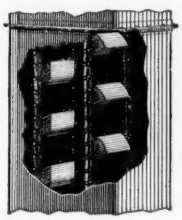


Bucket Carriers



Belt Conveyors

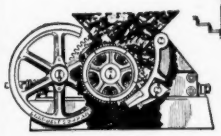


Bucket Elevators

Bulk-Flo

Screw Conveyor

Skip Hoist



Coal Crusher

Feeders

Car Dumper

Weigh Larry

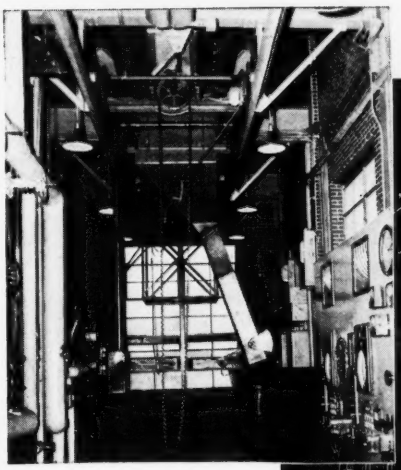
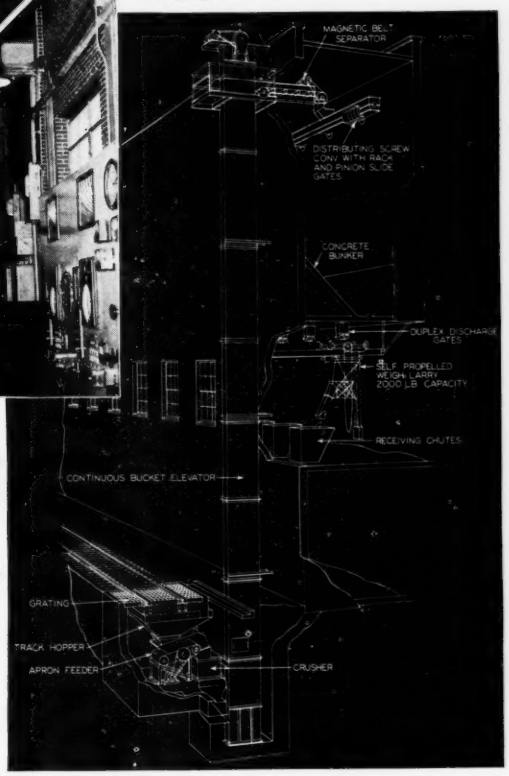


Photo at left shows interior of boiler room with weigh larry in foreground, at Riegel Textile Company.



LINK-BELT Coal Handling System *provides flexibility at Riegel*

In the boiler plant phase of the continuous modernization of Riegel Textile Company, Trion, Ga., flexibility was a major consideration. To circumvent fuel emergencies, the two steam generators were planned to switchover from one fuel to another.

Flexibility and efficiency in coal handling are provided by an integrated system of Link-Belt standardized units. The sketch above shows the components. Coal is received through grating to track hopper. An apron feeder serves the pulverizer. Crushed coal is taken by bucket elevator to top of bunkers where it is distributed by screw conveyor. Duplex discharge gates permit self-propelled weigh larry to distribute to coal receiving chutes.

We will be glad to give you further details of this and other cost cutting installations. Get in touch with our nearest office.

LINK-BELT COMPANY

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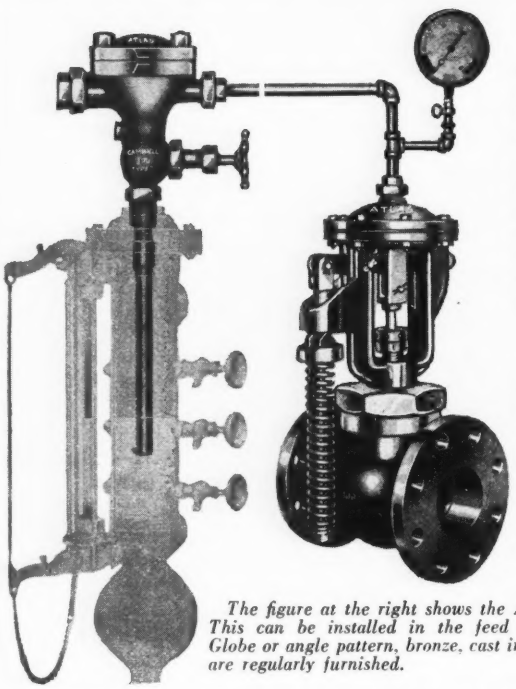
COAL AND ASHES HANDLING EQUIPMENT

CAMPBELL
Boiler Feed Water Regulator



An outstanding advantage of the CAMPBELL Feed Water Regulator is its extremely simple construction. There are no trouble-breeding parts, making it easy to install and eliminating the need for expert servicing.

The figure at the left shows the CAMPBELL Regulating Element. Note the simplicity of design and construction. Note how easy it is to install: just attach to any water column.

The figure at the right shows the ATLAS Control Valve. This can be installed in the feed water line anywhere. Globe or angle pattern, bronze, cast iron, or cast steel valves are regularly furnished.

Why Engineers Prefer the CAMPBELL

Briefly, these are the six points that operating engineers like:

1—Continuous Blowdown;
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3—No Thermostats;
4—No Floats;
5—No Links;
6—No Generators.

For many years the CAMPBELL has been successfully controlling all types and sizes of boilers. The slightest change in water level causes the regulator to operate the largest control valves instantly. Rugged. Efficient. Economical. No fine adjustments. 50 to 400 lb. pressure, and up. Sizes 1" to 6". Guaranteed.

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- ☐ Reducing Valves
- ☐ Exhaust Control Systems
- ☐ Pump Governors
- ☐ Oil Control Cocks
- ☐ Humidity Controllers
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

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At 0.5 cents per kwhr, this represents $977.50 per year which, capitalized at 15 per cent, is equivalent to approximately $6500.

This analysis was repeated for a 400-gpm, 500-psi installation, involving a 200-hp motor, and showed that the capitalized savings amounted to approximately $1650.

It must be stated that in neither case was credit given to the constant-speed pump for the throttled excess pressure—recovered in the form of heat. On the basis of the figures shown in Table IV, the 700-hp constant-speed installation would have to be credited with 46,100 kwhr per year, reducing the yearly savings obtainable from variable speed drive to $747; and the capitalized equivalent for the 200-hp unit would be reduced to $1270. Expressing this in terms of dollars per horsepower, we get:

700-hp unit.....$7.14 per hp.
200-hp unit.....$6.35 per hp.

Since the difference between the two figures is relatively small, it could be stated that in order for the variable-speed drive to be economically justifiable, its cost, including special controls over and above those needed for standard squirrel-cage motor drive, should not exceed $6.00 to $7.00 per hp for the entire range of boiler feed pump motor sizes.

Factors Affecting Comparison

It is further necessary to caution anyone using this figure that the assumptions used in comparing constant and variable-speed operation are subject to very wide variations. The shape of the pump characteristic curve, the actual system-head curve, the load factor of the installation and the method of evaluating power costs all enter intimately into establishing the justifiable cost per horsepower of the variable-speed drive.

For instance, it must be considered that the performance of the boiler feed pump shown on Fig. 4 is based on a normal boiler feed pump selection when constant-speed operation is the most general type of service and for which very definite limitations are imposed both on the shape of the head capacity and on the relation of the maximum efficiency capacity to the full-load capacity of the boiler feed pump in question. Constant-speed boiler feed pumps are limited in the permissible rise in pressure between the contract conditions and shut-off, because a large rise in head would impose excessive pressure on the piping heaters and valves located in the pump discharge and would render feedwater level control of such pumps rather difficult. If the boiler feed pump is operated at variable speed, this restriction disappears.

As a result, it may be possible in certain cases to select a pump char-

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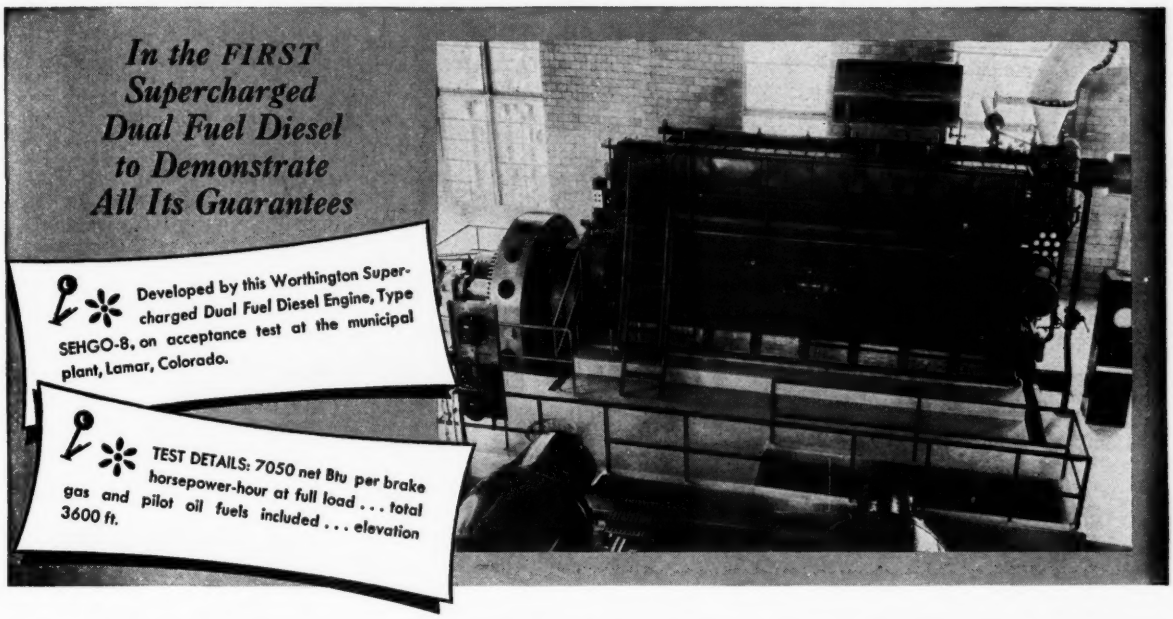
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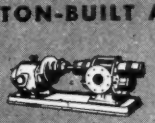
Oil Transfer Pumps

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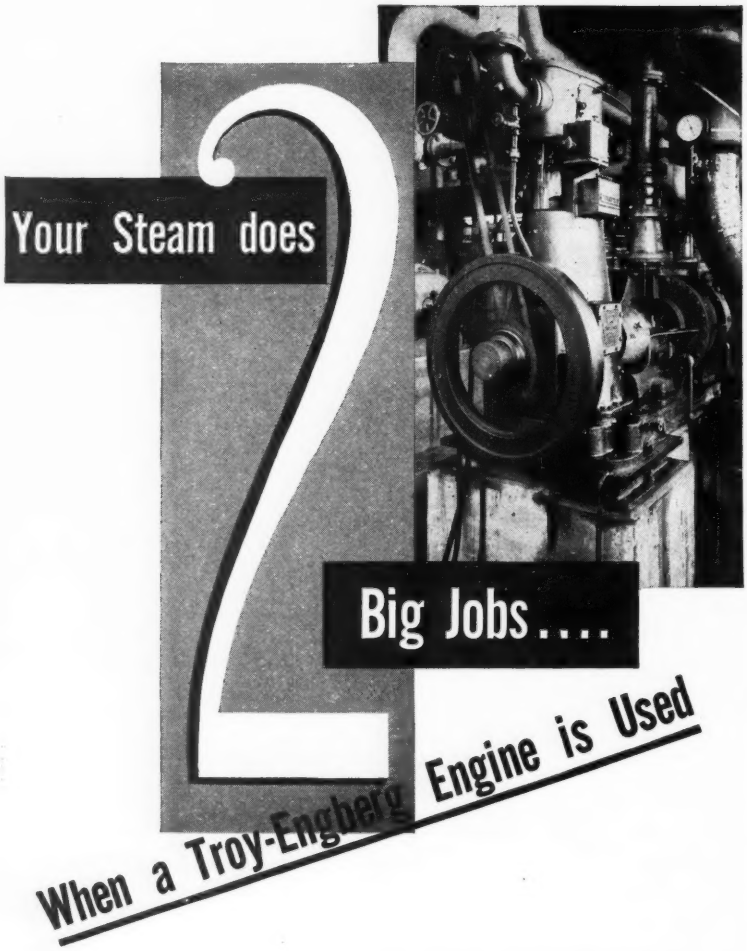

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acteristic such that the best efficiency point occurs at a capacity somewhat lower than the design capacity, in which case, of course, the rise of pressure towards shut-off is considerably greater than in normal cases. This rise, however, is not objectionable under variable-speed operating conditions; and the net result of such a selection is a material improvement of the overall efficiency of the installation at partial loads, an improvement which was not indicated in the comparison shown on Table III.

Influence of Pump Characteristics and Pressures

Of course, it may not always be practical to provide a pump characteristic of this type. For instance, until such time as variable-speed operation of boiler feed pumps becomes the rule rather than the exception, it may not always be possible to obtain such a performance curve in the range of conditions where a standard line of casing patterns of the axially-split casing type has been developed by pump manufacturers, that is, in the pressure range up to approximately 1250 psi. Furthermore, operating a boiler feed pump at capacities greatly in excess of the capacity at the maximum efficiency may be restricted in some cases by suction condition limitations.

Another very important consideration in connection with the use of variable-speed drives is that the net pressure for which a boiler feed pump will be designed is actually appreciably lowered if the pump is to operate at variable speed. This is due to the fact that, if a pump or group of pumps are to serve a single boiler, the function of the feedwater regulator and of the excess pressure regulator disappears. Thus, the losses through these regulators can be eliminated from the required discharge pressure calculations. If more than one boiler is served by the same group of pumps, each boiler must be provided with its feedwater regulator, but the excess pressure regulator losses are still eliminated.

In addition, it must be remembered that it is a general practice to add a liberal safety margin in the calculations of the discharge pressure. In the case of constant-speed pumps, this safety margin will be throttled off under normal operating conditions, at the cost of unnecessary excess power expenditure. If, however, the pump is operated at variable speed, the feedwater level control, which determines the pump speed, will slow down the pump to the point where this excess power is no longer expended.

Summary of Variable-Speed Savings

Taking all these facts into consideration, it is safe to state that in numerous cases a figure of $10.00 to $11.00 per hp might be used as an evaluation of the savings accru-

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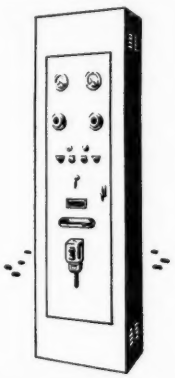
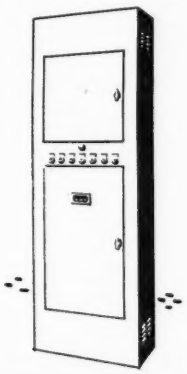
The many and varied factors affecting the operating efficiency of a COTTRELL Precipitator make experience and "know how" of the greatest importance in designing and installing COTTRELL equipment. Western Precipitation Corporation—*the organization that pioneered the commercial application of* COTTRELLS—has had over 39 years of first-hand experience in developing and perfecting the various elements that make up a complete COTTRELL installation, and these years of experience assure maximum performance from every Western Precipitation COTTRELL installation.

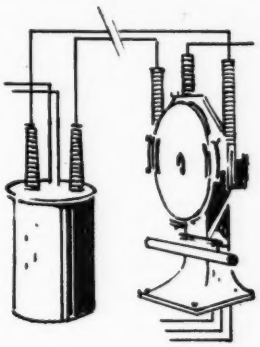
For example, the equipment for energizing Western Precipitation COTTRELLS include such features as the following . . .



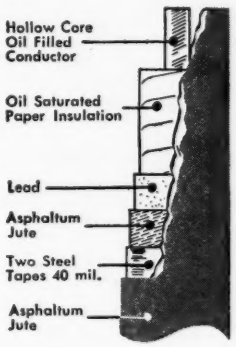
RECTIFIER SWITCHBOARDS—are of the Enclosed Cubicle type with flush-mounted meters, push buttons, selector switches, and indicating lights. The cabinet door and rectifier control circuit are interlocked. Rectifier and transformer contactors, instrument transformers, tap switches, terminal blocks and other auxiliaries are mounted inside the switchboard cabinet.



RAPPER AND POWER PANELS—are of the same external appearance as rectifier switchboards and can be installed beside rectifier switchboards to form a uniform and continuous switchboard installation. The cabinet is divided into two compartments—one containing AB breakers for control of all individual rectifier and signal circuits—the other containing all rapper controls and timers.



RECTIFIERS—for either full or half wave rectification. Mechanical rectifiers of the solid disc type are supplied with Radio Interference Correctors and Inductive Type Automatic Polarity devices. The Automatic polarity device has no commutator or brushes contacting high speed rotating parts. High voltage switch gear with interlocking control units is available.



HIGH VOLTAGE CONNECTIONS—between the rectifiers and the COTTRELL may be either special high voltage petrolatum-filled lead and steel-covered cable with pothead terminal connections, or of rod-and-bus-duct construction.

Watch for the next in this series which outlines the various* COTTRELL *electrode systems available from Western Precipitation Corporation.

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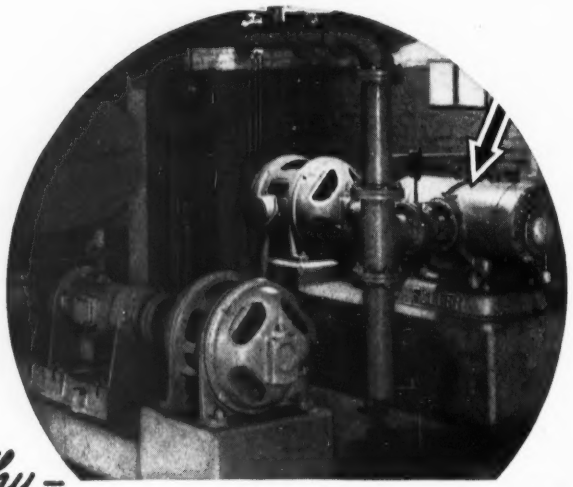

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The installation illustrated above is a very good example of a Fuller "spotted" unit. Compressed air was available from a central compressor station but at a much higher pressure than needed for that particular work to be done. Rather than use air through a reducing valve, with the attendant losses, it was decided to install a Fuller Rotary Compressor to produce air at the desired pressure. This resulted in considerable saving in power, costly transmission lines, friction losses and line leakage. And, when the department has completed its daily cycle of operation, the compressor is shut down.

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C-159

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ing from the operation of the boiler feed pumps at variable speed. Such savings are quite appreciable and in a great many cases they may be more than sufficient to justify the necessary increase in first cost. Further, while these power savings are the only tangible item that lends itself to a direct evaluation in dollars and cents, they are not the only advantages that may be derived from variable speed operation. Further operating advantages may be listed as:

(a) Reduced wear and tear in the pump at part capacities where most of the destructive action occurs and where a considerable portion of pump operation takes place.

(b) Reduced maximum operating pressure on the discharge piping and equipment such as closed heaters located in the boiler feed pump discharge.

While these advantages are difficult to evaluate, they will be appreciated by power plant designers and operators. Thus, it is logical to predict that the future of the variable-speed drive application to obtain variable speed boiler feed pump operation is bright.

ULTRASONICS

(Continued from page 88)

mately 35,000 cycles per second and an intensity of 160 decibels. About 96 per cent of the carbon black is recovered from the gas stream.

In addition to this carbon black recovery installation, a number of other applications are either under way or being projected or studied.

One is an installation at a paper mill in Maine for soda recovery from the stack gases of a large modern recovery unit. This sonic unit is designed to handle 70,000 cfm of exhaust gas from the recovery unit. A similar installation for salt cake and soda recovery from 40,000 cfm of stack gases is being made at a kraft pulp mill in the Pacific Northwest.

Chemical Recovery and/or Stack Gas Cleaning

Recovery of aerosol particles from smokes, mists, fumes, has assumed great importance in recent years in various industries. Recovery of valuable materials from gas streams in certain processes—for example, sodium compounds from the furnace gases issuing from paper mill recovery units—is one problem. (Since a paper mill recovery unit is at the same time a steam-generating unit, the operation involves the power engineer as well as the paper mill engineer.)

Then there are problems in which either chemical recovery or nuisance elimination, or the two combined, must be solved. These involve fumes from acid and other chemical plants. Steel mill furnace stack gas and

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stack gases of power plants must be cleaned primarily as nuisance elimination. The public clamor for abatement of smoke and dirt from industrial stacks is becoming a powerful influence on these problems.

Boiler Flue Gas Cleaning

There is much interest throughout the power engineering field in the possibilities of this process for boiler flue gas cleaning. An experimental sonic collection installation for removing fly ash from boiler flue gas has been made at the Somerset Station of Montaup Electric Co.

It is also reported that in this installation the possibilities of ultrasonics for boiler tube cleaning, by vibrating tube deposits, is being investigated.

Ultrasonics in Combustion of Coal

Also of interest to power engineers is the report that a company in New York is experimenting with sound vibrations in the combustion process itself. The idea is that if burning coal particles could be held in suspension in the combustion air for a long time by using ultrasonic vibrations, the gases of combustion would be swept away from the coal particles faster and they would receive more combustion air and burn more completely, leading to use of a smaller combustion space.

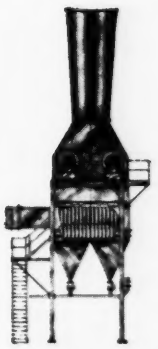
Experiments along this same line, in the vibratory firing of pulverized coal, are also reported from Europe. According to F. H. Reynst in *Chaleur et Industrie* (Heat and Industry) March 1948, the gas layer around a pulverized coal particle can be swept away by imposing acoustic vibrations upon the gas body containing the particle. This will allow access of fresh supplies of oxygen to the latter.

The vibrations will propagate through the entire body of the gas and produce a relative motion between gas and fuel particles.

Oscillations of this type can be produced by the "singing flame" principle, it is stated. In an installation described by Reynst, a blower supplies a mixture of air and pulverized fuel to a precombustion chamber, then through a venturi-shaped duct leading to the burner firing a Scotch boiler furnace. The shape of the ducts causes the entire gas body to oscillate, and the oscillations exert a force on the gas because the shaped duct offers a greater resistance to flow in one direction than in another. The frequency of the oscillations is designed so that the body of gas in the furnace is in resonance.

It is conceivable that these oscillations could also be created by ultrasonic vibrations applied from outside.

Further, it is understood that one of the large Midwestern utility companies is making some experiments of its own along this or similar lines in the use of ultrasonics, both in im-



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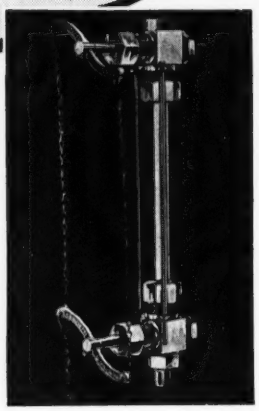

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proving combustion and in cleaning flue gas.

Ultrasonics in Paper and Chemical Plants

Other applications of ultrasonics are being considered for paper mills. One of these will be to accelerate paper formation. An experimental unit for this purpose will be installed on a paper machine at the plant of Southern Advance Bag and Paper Co. (See POWER GENERATION, June 1948). This unit will be designed to vibrate paper stock at the headbox of the paper machine, thus accelerating removal of water from the stock and also speeding up and modifying the felting and formation of the paper sheet.

In the chemical field, too, applications of sonic collection are being made. A manufacturer of sulphuric acid is studying the use of the method in precipitating sulphuric acid mist. Here design of lead-lined agglomeration tanks and other equipment, specially-designed baffles for separators and similar problems must be worked out. One large soap manufacturer has a pilot plant sonic collection system for aiding spray drying of powdered soap.

Ultrasonics in Metal Working

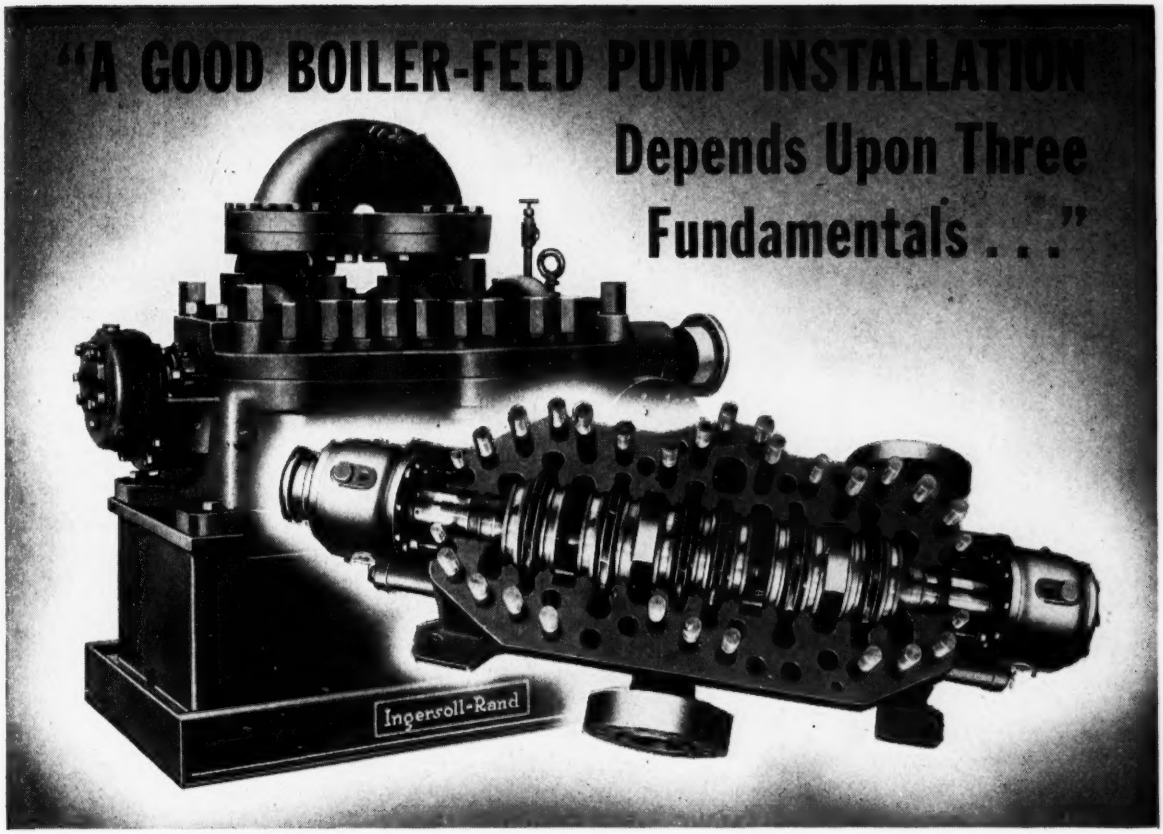
There are other new uses of ultrasonics in testing welds; for example, a supersonic reflectoscope has been used. As developed by Sperry Products, Inc., a new angle-beam transmission technique permits welds in steel plate up to 5 in. thick and in walls as thin as $\frac{1}{16}$ in. to be inspected, and detects small defects in welds extremely hard to locate by X-ray or other non-destructive testing.

Supersonic methods are being used to inspect forgings for the Allis-Chalmers coal-burning gas turbine now under construction.

Sonodizing, for soldering aluminum, stainless steel and chrome plate, is being carried out at Lockheed Aircraft Corp. In this process, a magnetostriction type of device transforms high-frequency electrical impulses into high-frequency mechanical vibrations in and around a soldering tip, the vibrations breaking up the oxide coating that forms when the metal is heated; this allows the solder to flow evenly and join the metals before the oxide coating can form again.

These are relatively small-scale uses of ultrasonics. But now, with the new mechanical sound generator capable of handling gas volumes of the order of 70,000 cfm or more and agglomerating particles smaller than 10 microns into larger particles, we have an industrial tool that will be studied closely by all engineers—and especially by power engineers.

"A GOOD BOILER-FEED PUMP INSTALLATION Depends Upon Three Fundamentals . . ."



The "RT" —a medium pressure boiler-feed pump

"A good boiler-feed pump installation depends upon three fundamentals; namely, design, manufacture, and operation. If any one of these is slighted, disastrous consequences soon follow."* After careful analysis of all pertinent facts Ingersoll-Rand developed the "RT" pump, a unit that has proven itself in service to successfully incorporate the first two of these important fundamentals and facilitates the operator's arriving at the third.

Design — A wealth of experience and knowledge goes into the design of each element, such as: one-piece, closed-type impellers, a close press fit on the shaft—discharge volute passages of the various stages, placed in relative position with reference to one another so that any side reactions on impellers cancel one another and have no effect.

Manufacture—Ingersoll-Rand manufacturing methods stand at the head of the pump field because: careful selection of materials are proven and tested by an experienced metallurgical department—competent and experienced personnel assemble and inspect each element—rigorous testing is carried out in the most modern and fully equipped testing laboratory of its type. All this and more leads to the final objective, perfection in operation.

Operation — A few other important features that make for perfection of operation include:

- Extra deep, water-cooled stuffing boxes that are provided with removable throat bushings. Both stuffing boxes are under suction pressure.
- Pump bearings sealed by labyrinth-type flinger rings to keep water and dust from entering the bearing housing.
- An accurately machined, ground and polished high-strength alloy steel shaft of ample proportions to insure low stresses. These are just a few of the refinements that contribute to the success of the "RT" pump in the medium pressure boiler-feed field.

**From an article by A. H. Richards, "Combustion".*

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ATOMIC ENERGY

(Continued from page 71)

atomic power for small, mobile units. But for a use like that of ship propulsion where the added weight of the plant might be more than offset by elimination of vast quantities of fuel for long voyages, atomic power looks quite promising. One would be inclined to guess that at first, successful use might come for naval propulsion where the ability to keep at sea for long periods without refueling might well outweigh higher unit operating costs. For use on land considering the weight and bulk of the necessary installations, a large reactor comparing in output with some of the largest central stations now being built, would have the best promise of reasonable costs. In such a case it would come into direct competition with present sources of power. If it ever is to compete at all it is clear that where coal or its equivalent costs $20 a ton, atomic power will be used long before it will be considered in areas where coal costs are $6. To try to look farther ahead gets us more and more into a fog.

You have all seen and read statements upon the future of atomic power which sound very different from the one I have just given you. Some of them have come from sources which ought to know better. Others have just represented the blind trying to lead the blind and still others apparently were done in the manner of the Buck Rogers comic strip which normally doesn't let a few facts stand in the way of telling a sensational story. The reasons which make us believe that atomic energy is unsuitable for automobiles or any other small power use seems to be just as much facts of nature as the specific gravity, the melting point, or the color and odor of various chemicals and compounds.

As indicated in the beginning, the problem is first whether the nuclear reactor can produce net useful power at all. To that, those who are closest to the work think the answer is "yes" and the time period is considerable—let's say five to fifteen years.

Secondly, taking the answer to the first question as yes, we do not know enough about any of the major elements of cost to be able to say flatly whether it will or will not compete with present sources of power. But, from the little we do know and what we can infer, we believe that it can fit, first in places where power costs are a minor factor, or where present power costs are very high. Anyway, it seems probable that for many, many years it will never do more than supplement other sources of power to supply what seems to be an accelerated growth in world-wide demand.

THE ONE-MAN PLANT

The small plant picture has changed... Higher fuel and labor costs are chiefly responsible.

Today's small plant must be more efficient and require less operating labor. It should be a one-man plant. To effect maximum economy it should be conservatively designed to use a wide range of coal characteristics. Overall design should include complete mechanization with respect to coal and ash handling, and firing, plus a reasonable amount of instrumentation and controls. Interior and exterior cleanliness and low maintenance should characterize its operation.

To secure proper coordination and integration of all elements there should be *single responsibility* in the design and construction of this modern plant. These design features require the same high calibre of engineering as the large plant.

Few such plants are in existence today . . . there should be thousands. The time is now for progressive consulting engineers and combustion equipment manufacturers to combine efforts in modernizing small plant design. Consumers, too, should recognize that the additional investment required will pay out quickly and return large dividends.

The figures in the table below, which are typical for most areas, show the relationship of various methods of firing and that maximum economy is achieved by the fully mechanized coal-fired plant.

COSTS OF 150-HORSEPOWER PLANTS (100 psi)*

	Hand-Fired	Hopper Stoker	Hopper Stoker With Conveyor	Oil
Investment (Equipment)	$12,400	$14,630	$18,980	$14,230
Operating Costs, per year				
Fuel	11,600	9,800	9,800	16,320
Other Operation	8,530	5,340	4,440	2,880
Total Operating Costs	$20,130	$15,140	$14,240	$19,200
Saving Over Oil Firing	-0-	$ .4,060	$ 4,960	-0-

As a Service to Industry and in the interests of better fuel utilization the Fairmont Coal Bureau is collaborating with consumers, consulting engineers and equipment manufacturers in the design of small fully mechanized plants. If interested please write:

FAIRMONT COAL BUREAU

122 EAST 42nd STREET — NEW YORK 17, N. Y.

*From "Modern Methods for Mechanical Handling of Coal and Ash in the Small Boiler Plant," by Bituminous Coal Research, Inc.

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COME OUT OF THE KITCHEN!

(Continued from page 53)

was due to two factors. One is that lawyers, who predominate in our law-making bodies, and live by precedent, find it difficult to understand that science lives in the future, that if it were governed by precedent, progress would come to a standstill.

The second factor was our own failure to make ourselves heard and understood. This failure I find impossible to condone. If you will keep in mind that as late as two years ago, when their accomplishments should have been an endless topic of praise and wonderment, scientists were still being taken from their work to shoulder arms, we cannot hope for a better understanding in the future.

The Remedy—Short-range Objectives

What I do suggest, however, is that at the start we work for limited and definite objectives, and not shoot too high until we have strengthened our muscles and trained our marksmanship. What would appeal to me, for immediate objectives are these:

Select a vigilance committee to watch the daily press critically. This vigilance committee should call the press to account for every serious

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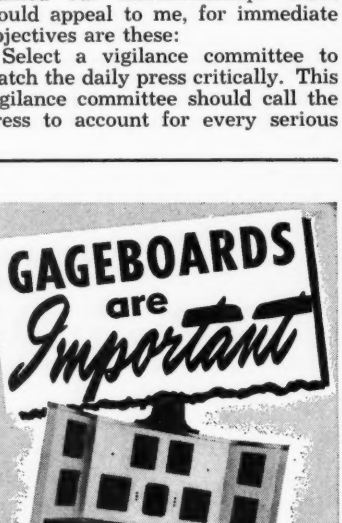

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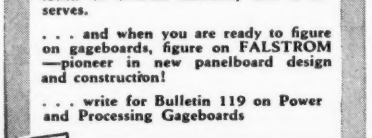
. . . write for Bulletin 119 on Power and Processing Gageboards



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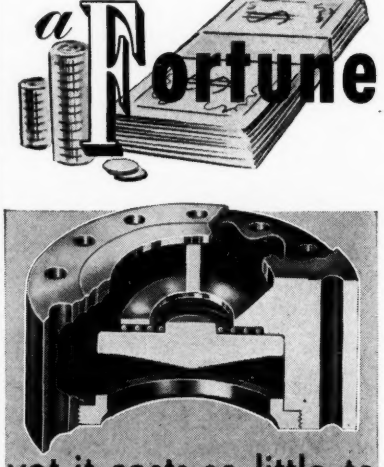
WATER HAMMER *can cost a* Fortune



yet it costs so little to correct with

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Used and specified on hundreds of new buildings—and installed on thousands of old buildings to prevent costly "Water Hammer" —the Williams-Hager Flanged Silent Check Valve will solve your problem, too! Write for new technical bulletin.

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error it prints. I recall with horror a statement in an editorial of a Metropolitan paper to the effect that one spectroscope can replace a dozen chemists. What a conception of a creative chemist this editorial writer must have had! In his mind a spectroscope invents, develops, sweats, spends sleepless nights. It is like saying that a new typesetting machine makes ten editorial writers superfluous. Yet, what happened after this slap at chemists had been published? Nothing. If a vigilance committee had gone to bat for us and had caused thousands of letters to be sent to the offending writer, he would have taken notice. He might not have retracted his error, but he would have been a good deal more careful in the future.

A committee of this kind, I should think, can be appointed at once. I would like to see it called "Vigilance Committee," to signify that it has teeth, and that it is not to be confused with the Publicity Committee. The Vigilance Committee should consist of men willing to fight. They will have to follow the daily papers and must not be afraid to hit them over the knuckles if they publish something which hurts our dignity or our interests.

The publicity committee, on the other hand, should constantly father news of interest to editors; it should make information of a technical nature available to them if they stand in need of it. If necessary, a consultant, who knows the newspaper business, should be hired to act in an advisory capacity. I venture to say that not more than a handful of Chicago people could tell you today what its scientists and technical men did toward winning the war which ended only 3 years ago, or what they have done before or since. I am tired of seeing us live the lives of modest violets. Violets are nice enough flowers, but after people have given them an approving glance, they usually step on them.

The remedy—Long-range Objectives

These objectives I have mentioned as examples are near at hand and should be attained without much effort. In my opinion, however, we should lay out two programs—one short range, one long-range. The creation of a vigilance committee, which involves practically no expense, belong to the first eategory. So does an active publicity committee. The long-range program calls for deep thought, but in a dim outline I can see some very worth-while objectives.

Out in Washington Park, within a few feet of the main east-west driveway, lies a large boulder. Do you know its story? It was brought to Chicago to honor the memory of Samuel Guthrie, one of America's pioneer chemists. He discovered chloroform and invented percussion caps. But the tablet, which was to identify the boulder, was never put on it, and the stone lies today, forlorn and forgotten, in mute testimony to the esteem in which our community holds the creative technical spirit. Would it be asking too much to do now what should have been done 40 years ago? The name Samuel Guthrie alone, even if engraved in gold, would not satisfy me. I would like to see on the tablet a commemoration of what he did. The completion of the Guthrie monument in itself may be of no spectacular performance, of course, but as a precedent it would be invaluable.

Another point I would recommend for consideration is a new way of naming streets, schools, libraries and other public institutions. So far as I know, the Steinmetz High School is the only one in Chicago named after an engineering genius. Of streets and libraries, I do not recall a single one.

Another thought I have in mind is one which I expressed in a recent radio broadcast in Charleston, West Virginia. With the consent and active co-operation of the large chemical concerns there, I described their latest products, and—here is where the pioneer step comes in—in addi-

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But you can trust RUSTOFF to remove rust, corrosion and discoloration in any water system.
RUSTOFF loosens, and disintegrates rust and at the same time forms a protective coating on the clean metal which protects it from corrosive effects of water or condensed steam.
RUSTOFF enables you to get more heat and unhampered water circulation by eliminating incrustations—thereby reducing fuel consumption and maintenance cost.
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Nicholson Expansion Steam Traps Solve . . . .

"SLOW HEAT-UP"
Due to Air Binding

MANY APPLICATIONS

This widely used Nicholson trap is applicable to all equipment using steam or hot water for heat or power, for example:

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Among the features of this simple and widely adaptable trap is its positive action. Closes tight when steam is in trap, opens wide when cold, rendering it proof against freezing and air-binding. Adjustable valve for passing condensate at any desired temperature. Pressures: 0 to 250 lbs. without change of valve or seat. Length: 18" to 40".

TRAPS FOR EVERY PURPOSE—power, heat, process. Weight and piston-operated traps for steam, air and gasoline pressures to 1500 lbs., thermostatic steam traps, pressures to 225 lbs.; radiator traps, pressures to 15 lbs. CATALOG 448.

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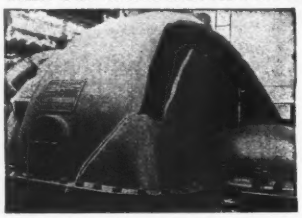
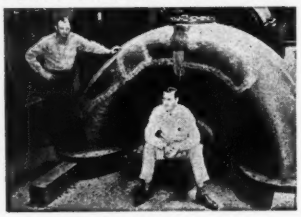


Before

10,000 KW Steam Turbine

After



Metalock repairs, made only by workmen thoroughly trained in this patented process, are accepted by manufacturers, users, underwriters. Send for free illustrated Metalock Bulletin No. 104 showing Fifty typical repair illustrations.

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tion the names and backgrounds of the chemists chiefly responsible for them. To my best knowledge this had never been done before, except a few months ago in Chattanooga, where I tried it out experimentally. Why should not similar methods of publicity be used universally? When a new bridge is opened, you see pictures of some high official cutting a silk ribbon, and the likeness of some city fathers who voted the necessary appropriation. Did you ever see in the front rank the engineers who built the bridge? That management is not adverse to this idea, the Charleston broadcast has demonstrated.

Now let me dream a bit further. Suppose the Technical Council should cause one day every year to be set aside as "Sci-En-Tech Day." On that day the city would be the host, and the guests would be those members of the various technical societies who have distinguished themselves during the past twelve months. They and their achievements would be there for everyone to see.

Each profession or group of professions has the public standing it deserves. If we technical men find ourselves near the bottom of the social ladder, the fault is ours, and ours only. Any betterment must come through ourselves. Grumbling and finger-pointing won't help.

PREVENT BOILER CORROSION

Oxygen, one very active source of destructive corrosion, is continuously detected and recorded by the Cambridge Dissolved Oxygen Analyzer. The oxygen dissolved in the feed water is determined directly. The oxygen set free by dissociation in the boiler is determined by measuring the free hydrogen in the steam. Cambridge Analyzers are available in models for recording O_2, H_2 or both O_2 and H_2 simultaneously.

Send for Bulletin 148 B.P.

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PRECISION INSTRUMENTS

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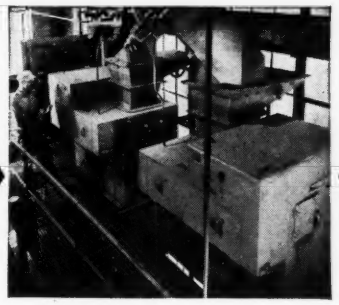

Typical installation of two Richardson Scales, right-hand and left-hand construction, floor-mounted with access platform between, in power plant of prominent rubber manufacturing company.

WEIGH

all coal accurately on Richardson Automatic Coal Scales

The excess dollars you may be "throwing on the fires" through inadequate coal control are avoidable—and can be eliminated with Richardson Coal Scales.

Continuous, correct readings give you an accurate means of determining the exact fuel consumption required for top boiler efficiency. This graphic information, when applied to future fuel consumption, assures you that minimum quantities of coal are burned for maximum efficiency at any rating.

Richardson complete bunker-to-boiler weighing and feeding system checks many coal dollar leaks. Scales are made in stationary, portable or elongated conveyor-scale combination; thus are adaptable to all plants, large and small, for either pulverizer or stoker-fired furnaces.

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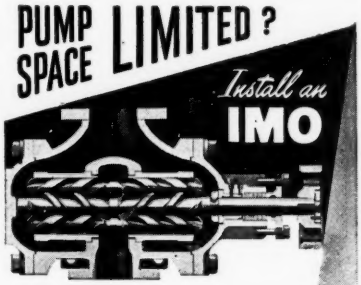
PUMP SPACE LIMITED?

Install an **IMO**



- The capacity of the IMO is increased by high speed operation. This compact pump can be directly connected to the driving machine without bulky speed reduction gearing.
- IMO Pumps can be furnished for practically any capacity and pressure required for oil, hydraulic-control fluids and other liquids.

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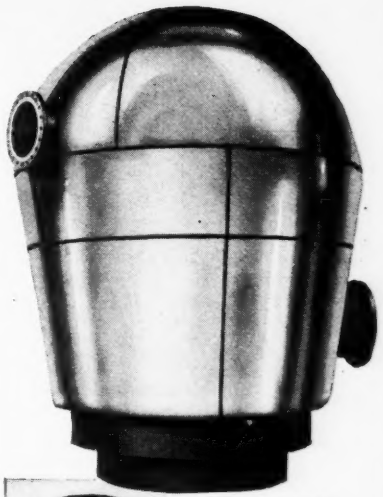

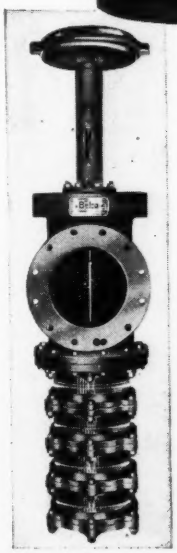

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This new Belco Deaerating Heater accomplishes both heating and complete deaerating in a few seconds time. The spray valve fills the stainless steel dome with a cloud of droplets which are contact heated and degasified by the inrushing steam. Intermingling of steam and water also drives out a portion of the CO_2 held in the bicarbonates.

Contact with heated baffle plates and impingment of counterflow steam insures complete removal of all gases. Degasified water is ejected into the deaerated storage compartment by the incoming steam—triple assurance that all traces of gas are removed before the water leaves the heater.

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POWER PLANT *Construction News*

Ala., Gadsden—Alabama Power Co., Birmingham, Ala., will proceed at once with superstructure for new steam-electric generating station at Gadsden, to be equipped for capacity of 120,000-kw. Completion is scheduled late in 1949. Cost reported in excess of $6,000,000, with turbine-generators, high-pressure boilers and auxiliary equipment.

Alaska, Ketchikan—Puget Sound Pulp & Timber Co., Bellingham, Wash., through its subsidiary, Ketchikan Pulp & Paper Co., organized several months ago, plans power house at proposed new wood pulp mill at Ketchikan. Work on project will begin in near future. Mill will comprise a number of large units and is estimated to cost close to $15,000,000. Company is acquiring extensive tract of timberlands near Ketchikan from Government, for raw material supply.

Ark., Pine Bluff—Arkansas Power & Light Co., Pine Bluff, has preliminary plans under way for new steam-electric generating station in Eastern Arkansas, with turbine-generators, high-pressure boilers and auxiliary equipment for large capacity. Cost reported close to $15,000,000, with transmission lines, power substations and other operating facilities.

Calif., San Francisco—Pacific Gas & Electric Co., 245 Market St., plans two new steam-electric generating stations on sites to be announced later, each to be equipped for rated capacity of 300,000-kw. Cost estimated at $103,000,000, with turbine-generators, high-pressure boilers and auxiliary equipment. Application for permission has been made to State Public Utilities Commission. Company also plans expansion in Kern Canyon generating station, Bakersfield, Calif., with installation of new hydraulic turbine and generating unit, estimated to cost about $12,800,000.

Del., Wilmington—Delaware Power & Light Co., 600 Market St., has authorized plans for new steam-electric generating station on site near city. Details are being determined. Proposed to begin work in 1949 and to have plant ready for service about 24 mos. later. Cost estimated approximately $20,000,000, with turbine-generators, high-pressure boilers and auxiliary equipment.

Fla., Tallahassee—Board of City Commissioners has plans under way for new municipal steam-electric generating station, estimated to cost about $5,000,000, with turbine-generators, high-pressure boilers and auxiliary equipment. Reynolds, Smith & Hills, 227 Park St., Jacksonville, Fla., are consulting engineers.

Fla., Worthington Springs—Clay Electric Cooperative, Inc., Keystone Heights, Fla., plans new power plant at Worthington Springs, using Diesel engine-generator units and accessories. Cost estimated close to $500,000. Work is expected to begin soon.

Ill., McCook—Armour & Co., Union Stock Yards, Chicago, Ill., meat packer, has approved plans for new boiler house at plant at McCook. Award has been made for structural steel framing and work will proceed at early date. No estimate of cost announced.

Kan., Hutchinson—Central Fibre Products Co., Hutchinson, paperboard specialties, has approved plans for new boiler house at local mill, reported to cost about $175,000, with boilers and auxiliary equipment. Erection will begin soon. H. M. Wilson & Co., 18th. and Brandywine Sts., Philadelphia, Pa., are engineers. Main offices of company are at 111 West Washington St., Chicago, Ill.

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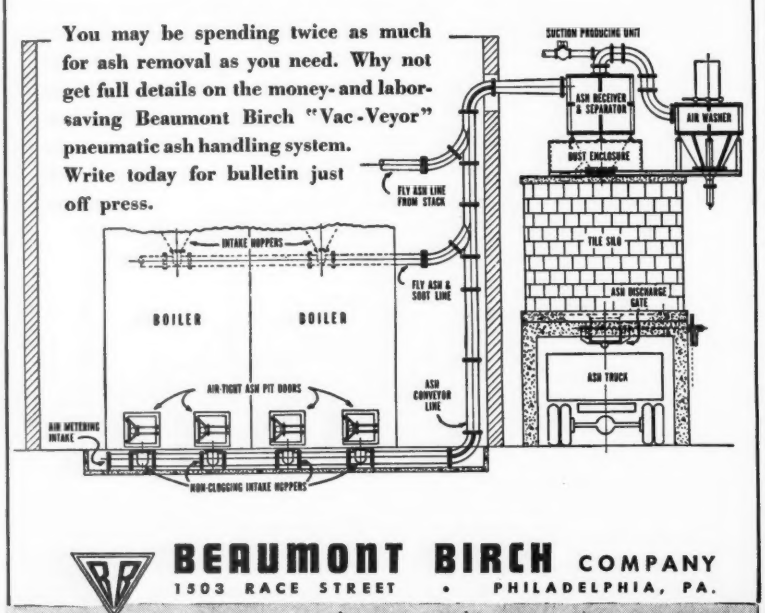
You may be spending twice as much for ash removal as you need. Why not get full details on the money- and labor-saving Beaumont Birch "Vac-Veyor" pneumatic ash handling system. Write today for bulletin just off press.



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FOR YOUR FILTERS
BROMOX
WORKS WONDERS IN HARD WATER AREAS

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- Cleans filter jets and breaks up colloids or mud balls
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- Is easy and economical to use

Write for data on what Bromox is saving in water filtering plants like yours.

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La., Sterlington—Louisiana Power & Light Co., New Orleans, La., will proceed with work early in fall on steel frame superstructure for proposed new addition to generating station at Sterlington. Installation will include new 60,000-kw. turbine-generator, high-pressure boiler and accessories. Completion is scheduled late in 1949. No official estimate of cost announced. Ebasco Services, Inc., 2 Rector St., New York, N.Y., is consulting engineer.

Mich., Detroit—Parke, Davis & Co., Joseph Campeau Ave. and River, drug and pharmaceutical products, has plans for new power house at plant, and will begin work soon. No estimate of cost announced. Smith, Hinchman & Grylls, Marquette Bldg., Detroit, are architects and engineers.

Minn., Cloquet—Wood Conversion Co., wallboard products, will build addition to boiler house at mill, with installation of additional equipment for increased capacity. Work will be carried out in connection with an expansion and improvement at mill to cost about $250,000. Pfeifer & Schultz, Wesley Temple Bldg., Minneapolis, Minn., are consulting engineers.

N.C., McCain—Bd. of Directors, North Carolina Sanatorium, plans extensions and improvements in boiler house at institution, with installation of additional equipment for increased capacity. Cost reported about $110,000.

N.D., Grand Forks—Northern States Power Co., Grand Forks, has plans for addition to local steam-electric generating station, with installation of steam-generating and other equipment. Ellerbe & Co., First National Bank Bldg., St. Paul, Minn., are consulting engineers.

Okla., Ponca City—Oklahoma Gas & Electric Co., Oklahoma City, Okla., has plans maturing for expansion in Lincoln Beerbower steam-electric generating station near Ponca City, with installation to include new 20,000-kw. turbine-generator, high-pressure boiler and auxiliary equipment. Work will be placed under way soon. Frank Partridge, company engineer in charge.

Texas, Howe—Lone Star Gas Co., 1915 Wood St., Dallas, Tex., plans new compressor station in vicinity of Howe, for booster service in connection with natural gas transmission. Cost reported close to $350,000 with compressors and auxiliary equipment. A similar station will be constructed near Munday, Tex., to cost approximately $200,000, with equipment.

Texas, Longview—Southwestern Gas & Electric Co., Shreveport, La., will begin work at once on foundations and sub-structure for proposed new Knox Lee steam-electric power plant on Lake Cherokee, near Longview. Station will be equipped for initial capacity of 70,000-kw., comprising two 35,000-kw. turbine-generators, high-pressure boilers and auxiliary equipment. Natural gas will be used as fuel. Cost reported over $6,000,000. Completion is scheduled late in 1949. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Texas, Waco—Water Dept., plans extensions and improvements in municipal water-works, including booster pumping station to cost about $75,000; filtration plant, $100,000; and elevated steel storage tank and tower, $100,000, Financing is being arranged. Joseph J, Rsdy, American Fidelity Bldg., Fort Worth, Tex., is consulting engineer.

Utah, Garfield—American Smelting & Refining Co., 120 Broadway, New York, N.Y., and Pacific National Life Bldg., Salt Lake City, Utah, plans power plant at proposed new acid works at Garfield, comprising several processing and production units. Entire project is reported to cost about $6,500,000. Proposed to begin work at early date.

Va., Front Royal—American Viscose Co., Front Royal, rayon products, has plans maturing for new addition to boiler house at local mill, with installation of boilers and accessories for increased capacity. No estimate of cost announced. Main offices are in Delaware Trust Bldg., Wilmington, Del.

Wis., Wausau—Underwood Veneer Co., Thomas St., has plans maturing for new boiler house at woodworking mill, and plans to begin work soon. No estimate of cost announced. Oppenhamer & Obel, Wausau, are architects.

Wis., Winnebago—State Dept. of Public Welfare, State Capitol, Madison, Wis., has plans for new power plant at State Hospital at Winnebago. No estimate of cost announced. Bids are scheduled to be asked soon. C. A. Halbert, State Capitol, Madison, is state engineer.

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MAXIM SILENCERS

This photograph shows 15 steam jet Air Ejectors equipped with Maxim Silencers, some of the larger ejectors handling up to 9000 lbs. per hour of non-condensible gases at 8" Hg Abs.

The reason why you find Maxim Silencers so frequently in these more complicated installations is the same reason why you find Maxims in such a large percentage of all silencer installations . . . the reason is experience, more practical experience more research and development experience. Silencing has been our business for years.

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You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

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Steps Up Efficiency!

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Lowers Maintenance Cost!

The "SPARK" That Burns the Soot!

What ALLADIN SOOT REMOVER Will Do For You:

1. Lower Fuel Costs!
2. Save time and labor!
3. Burn soot that cannot be reached by blowing, brushing or scraping.
4. Increase the evaporation rate, giving quicker steaming.
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6. Keep boiler tubes, breechings, passes and stacks clean.

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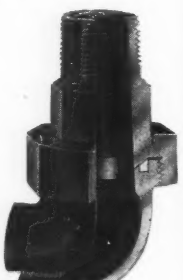
***Specialty* UNIONS**

Featuring the RECESSED BRASS SEAT

Save pipe joints and you'll save money



Savings in original installation through the use of Jefferson Specialty Unions is effected through simplification in piping and in the time and labor involved in making up joints. Once the installation has been made savings in maintenance are assured because there are fewer joints involved at points where unions can be most effectively employed.

The brass seating feature of all Jefferson Specialty Unions is insurance against shut-down because it assures leak-proof tightness without undue pressure. It can be made or broken without impairing the effectiveness of the seat. 90-degree Union Elbows are but one of the many types in which Jefferson Specialty Unions are available to save money and pipe joints. Consult us or your nearest distributor for further details.

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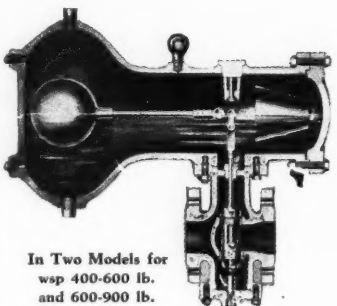
STETS FEED REGULATOR



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Office located in Eastern Iowa, must be able to travel, bulk of work in middle west, car not essential, salary commensurate with ability.

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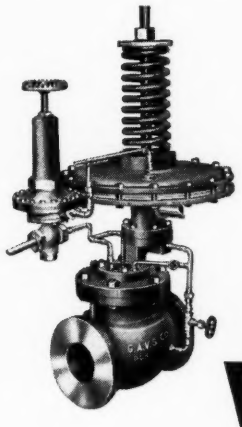

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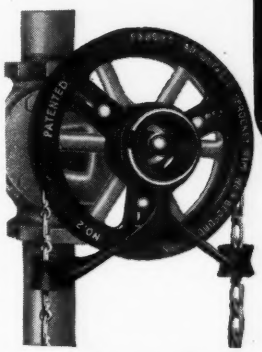

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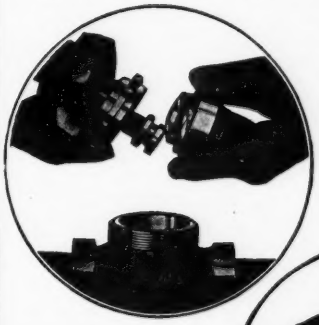

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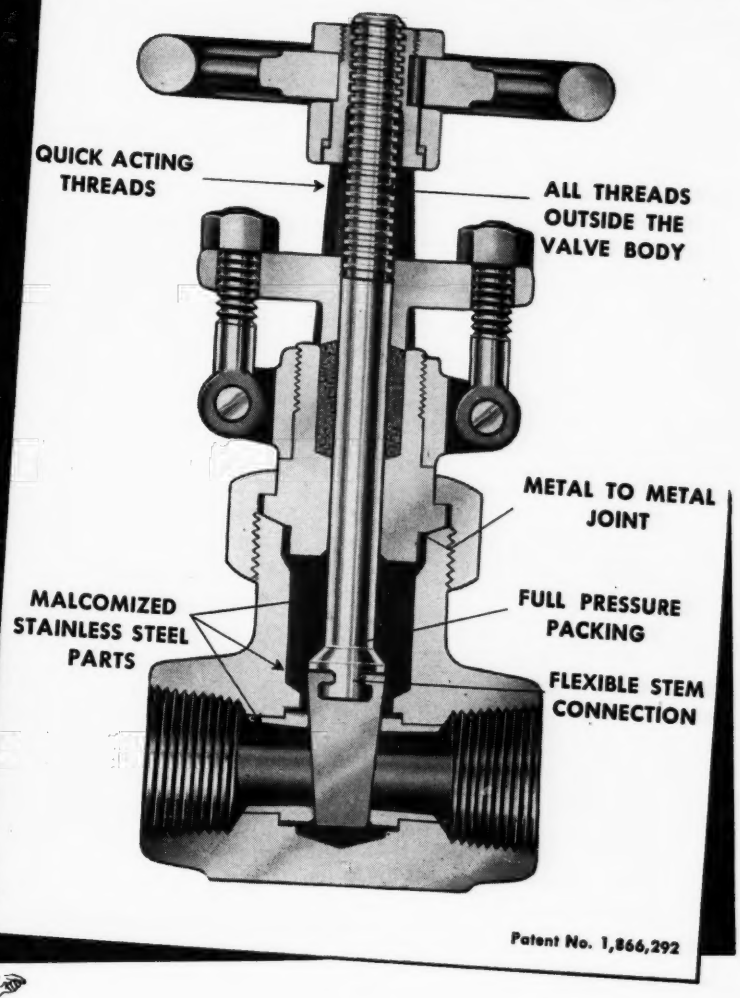

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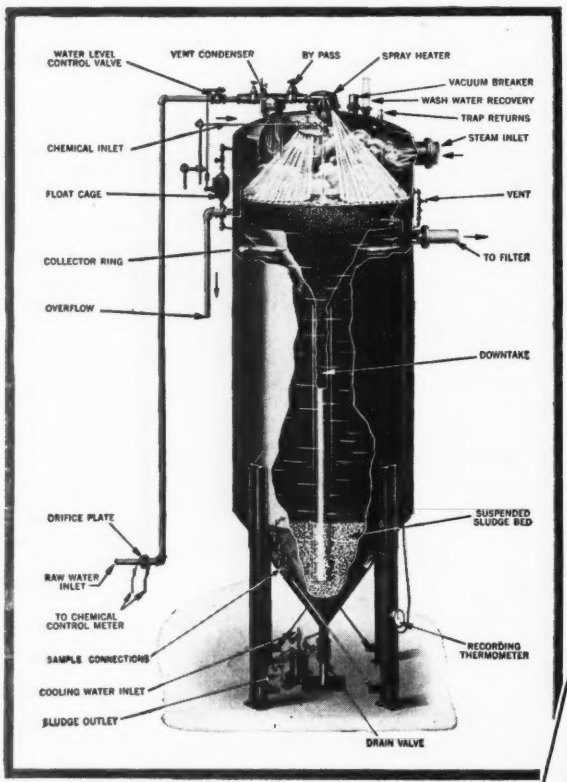
Low Silica Soft Water



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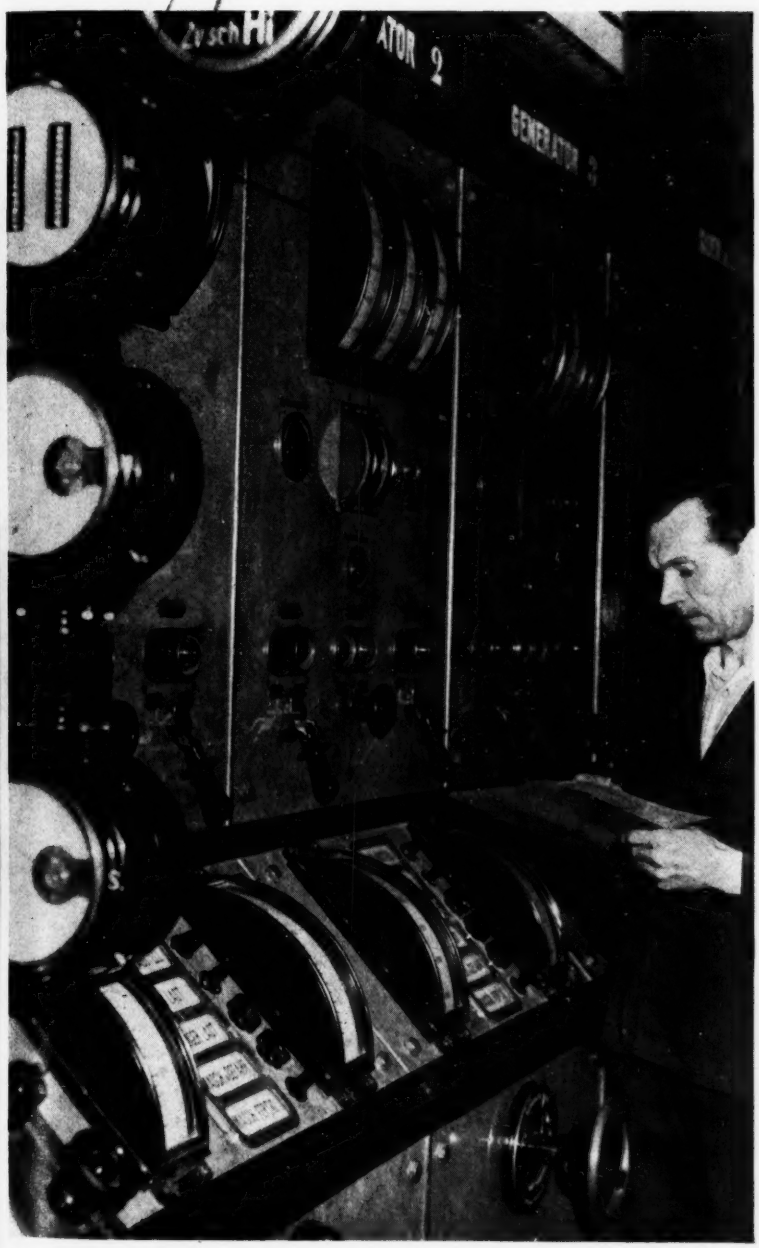

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German engineer checks meter reading in control room of Wilmersdorf power station, Berlin. The Berliner Kraft & Light A. G. plant, located in Wilmersdorf in British sector, can work only at low pressure because Russians removed 2 of the largest turbines.

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   Speed adjustment—3:1, while running.
   Steady-state speed regulation—4% at maximum speed, 10% at minimum speed.

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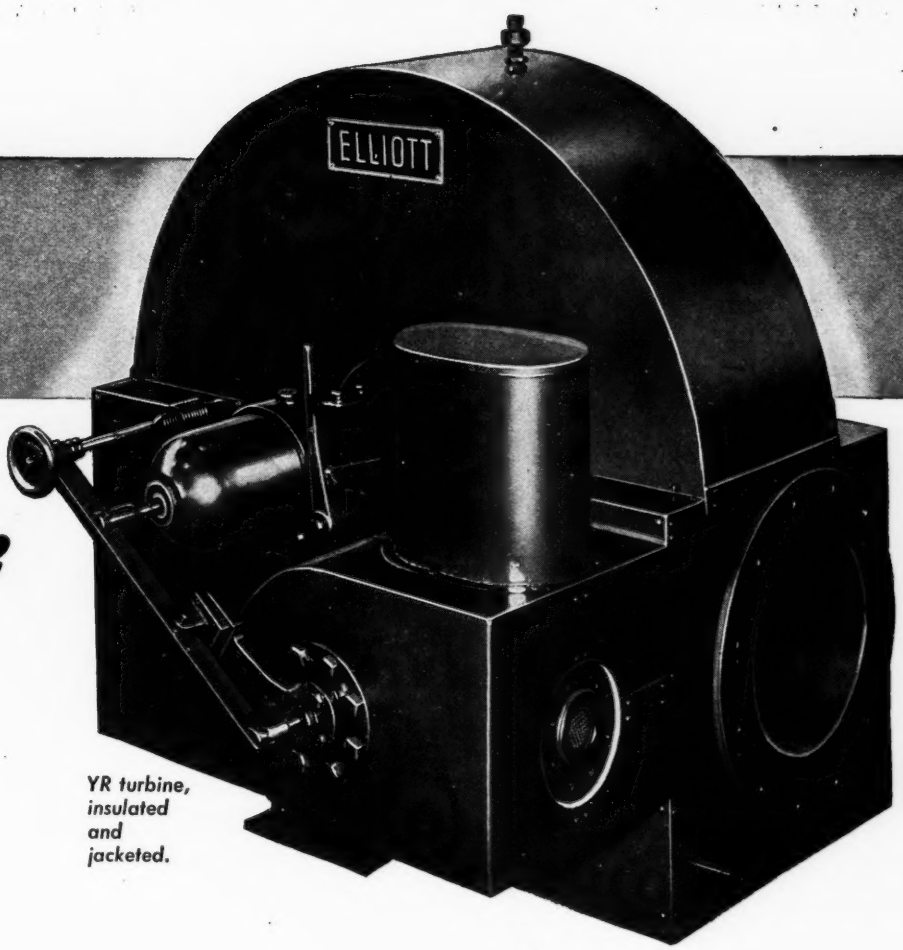

YR turbine, insulated and jacketed.

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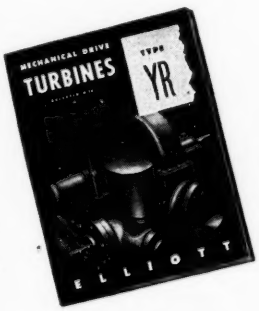

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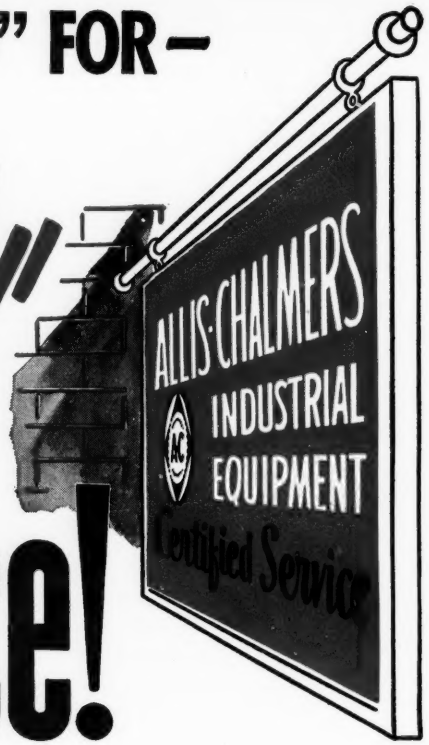

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